FIG. 1A

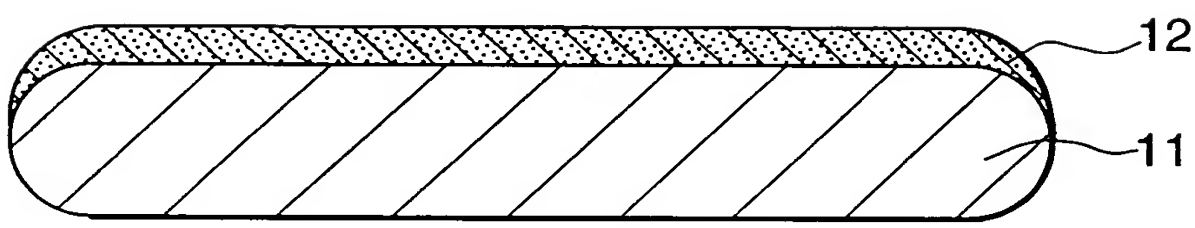


FIG. 1B

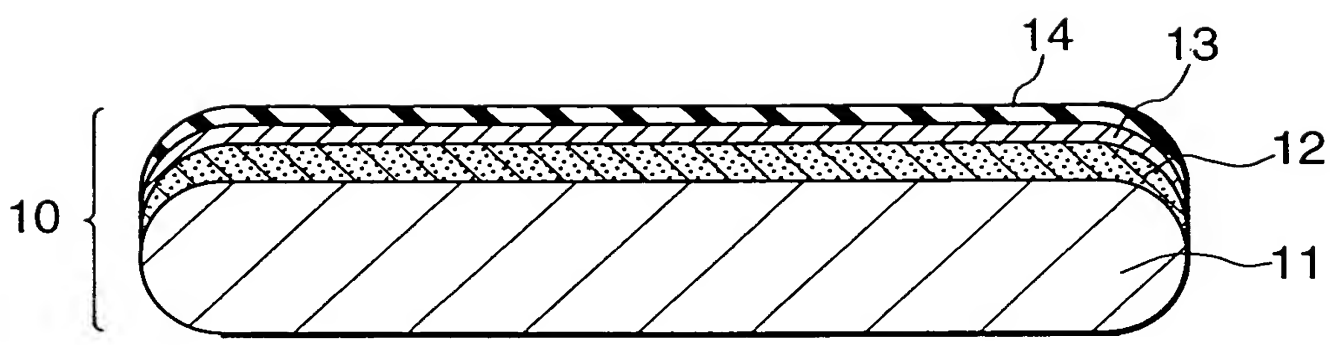


FIG. 1C

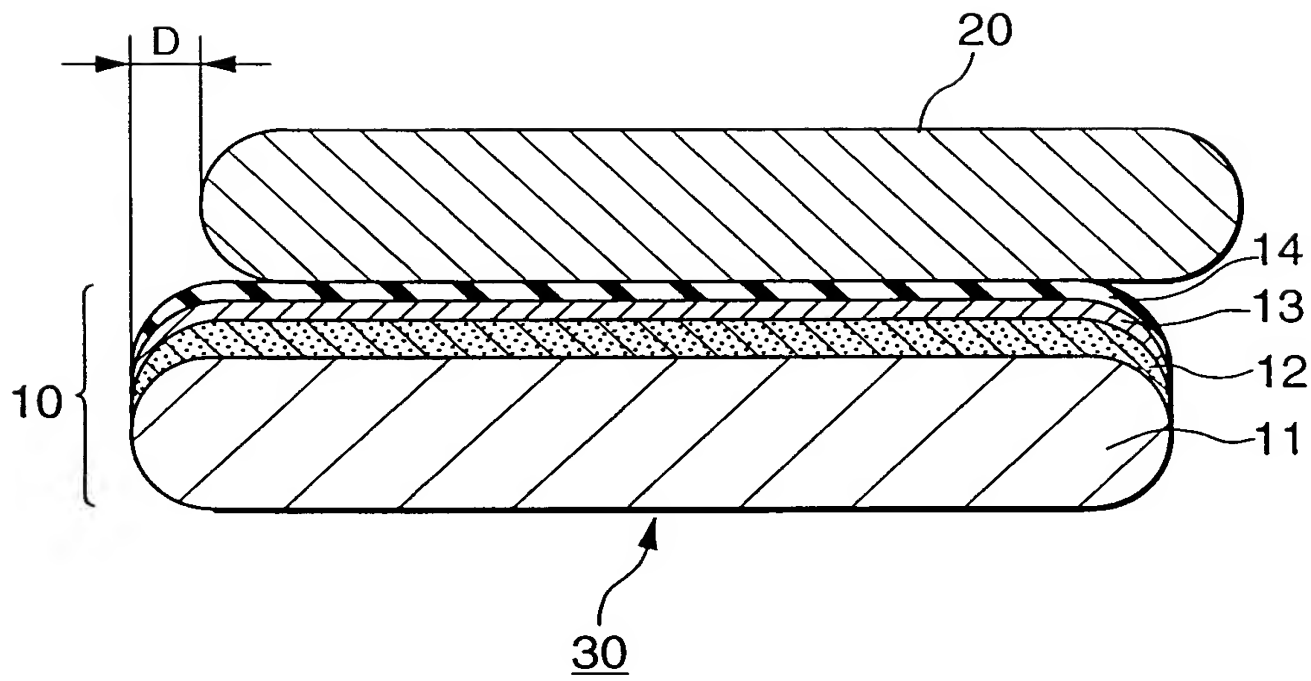


FIG. 1D

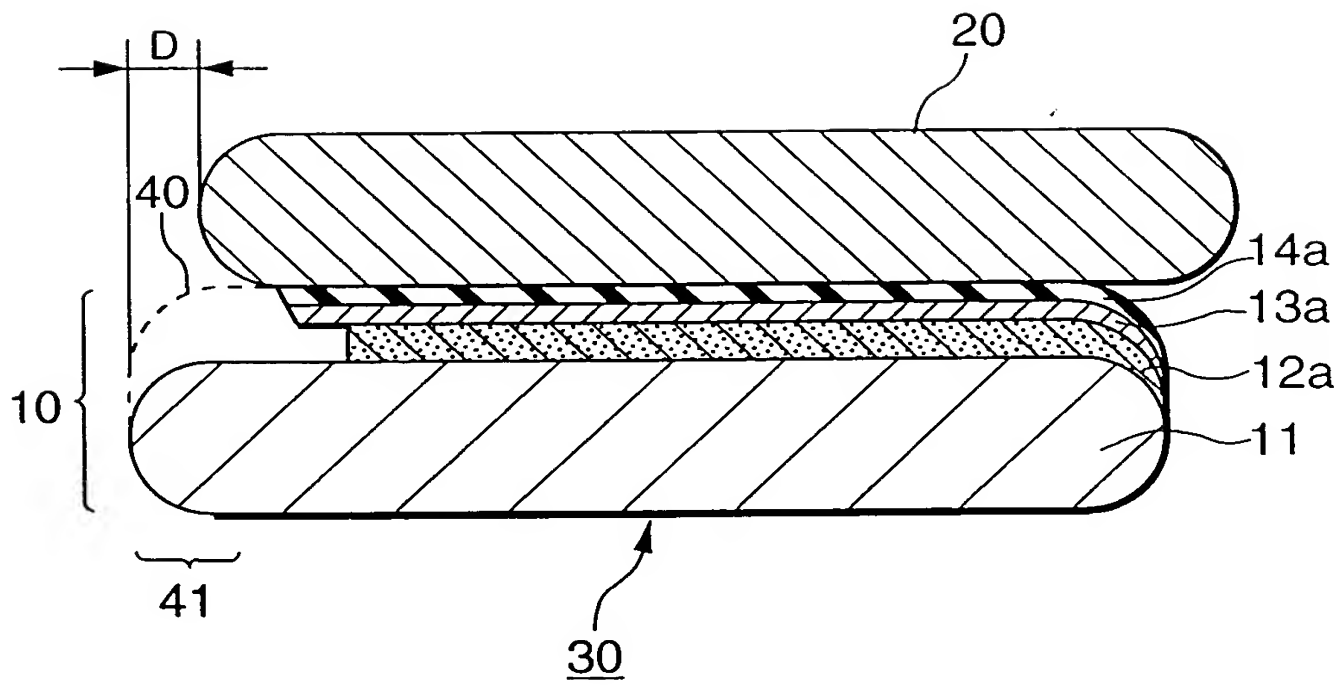


FIG. 1E

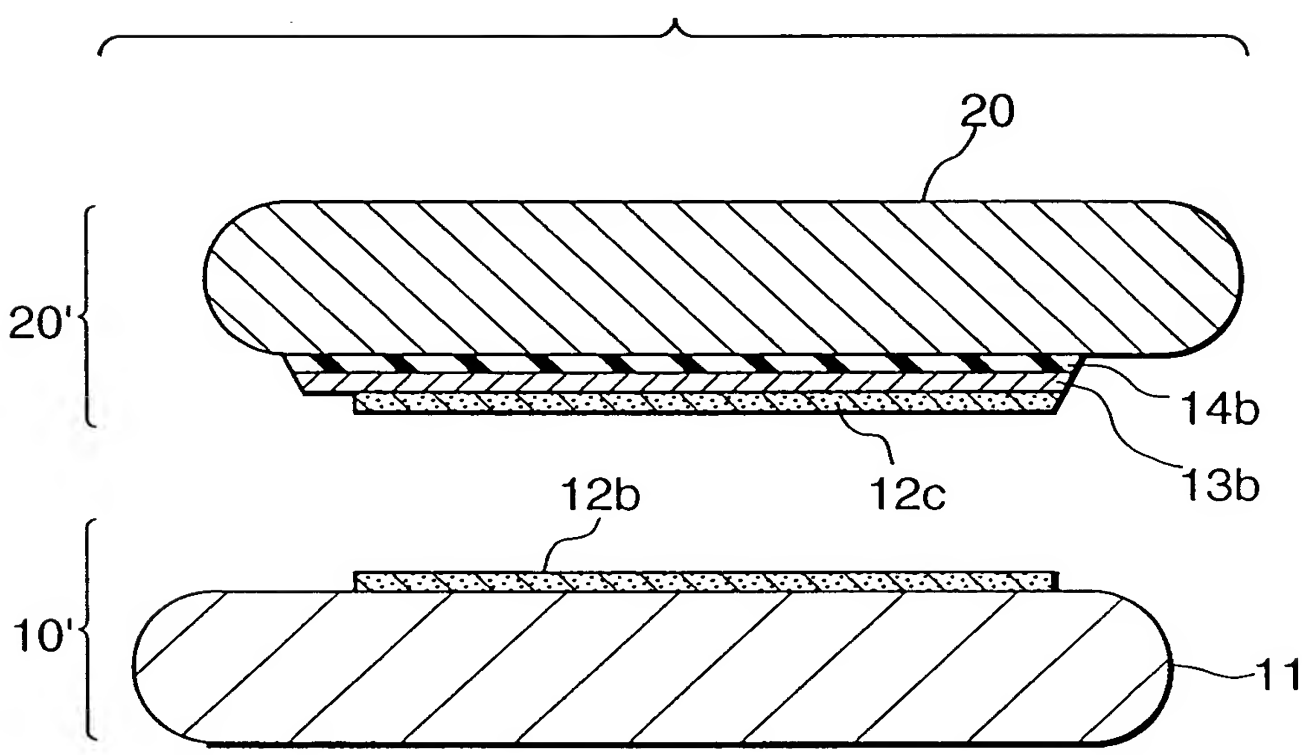


FIG. 1F

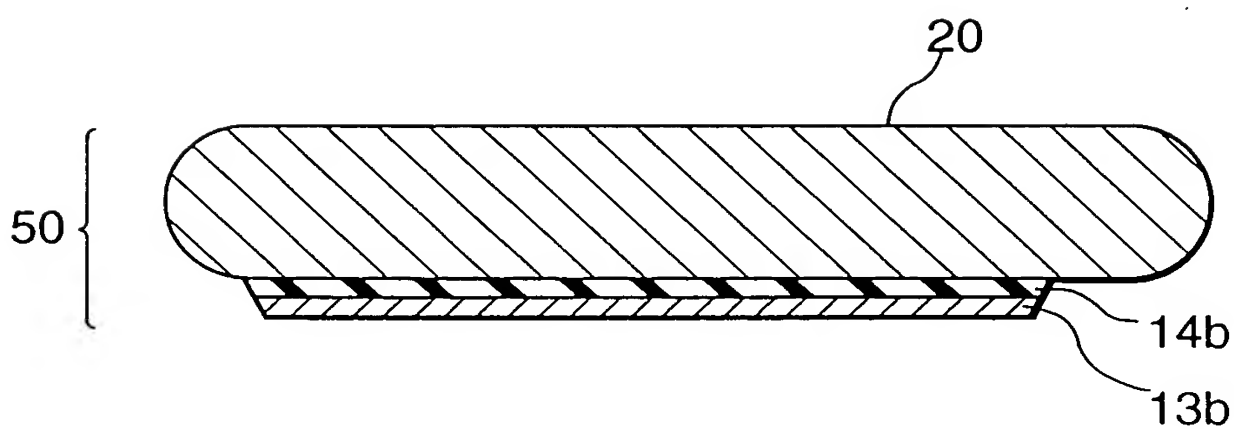


FIG. 1G

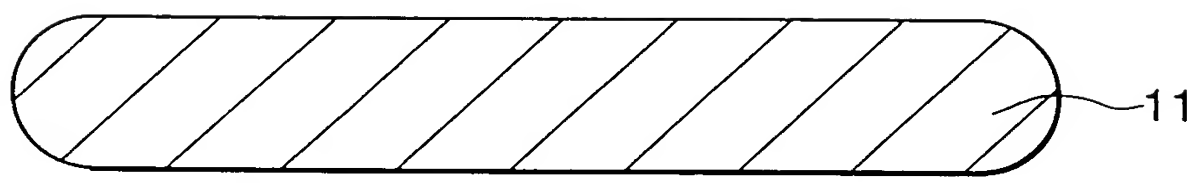


FIG. 2

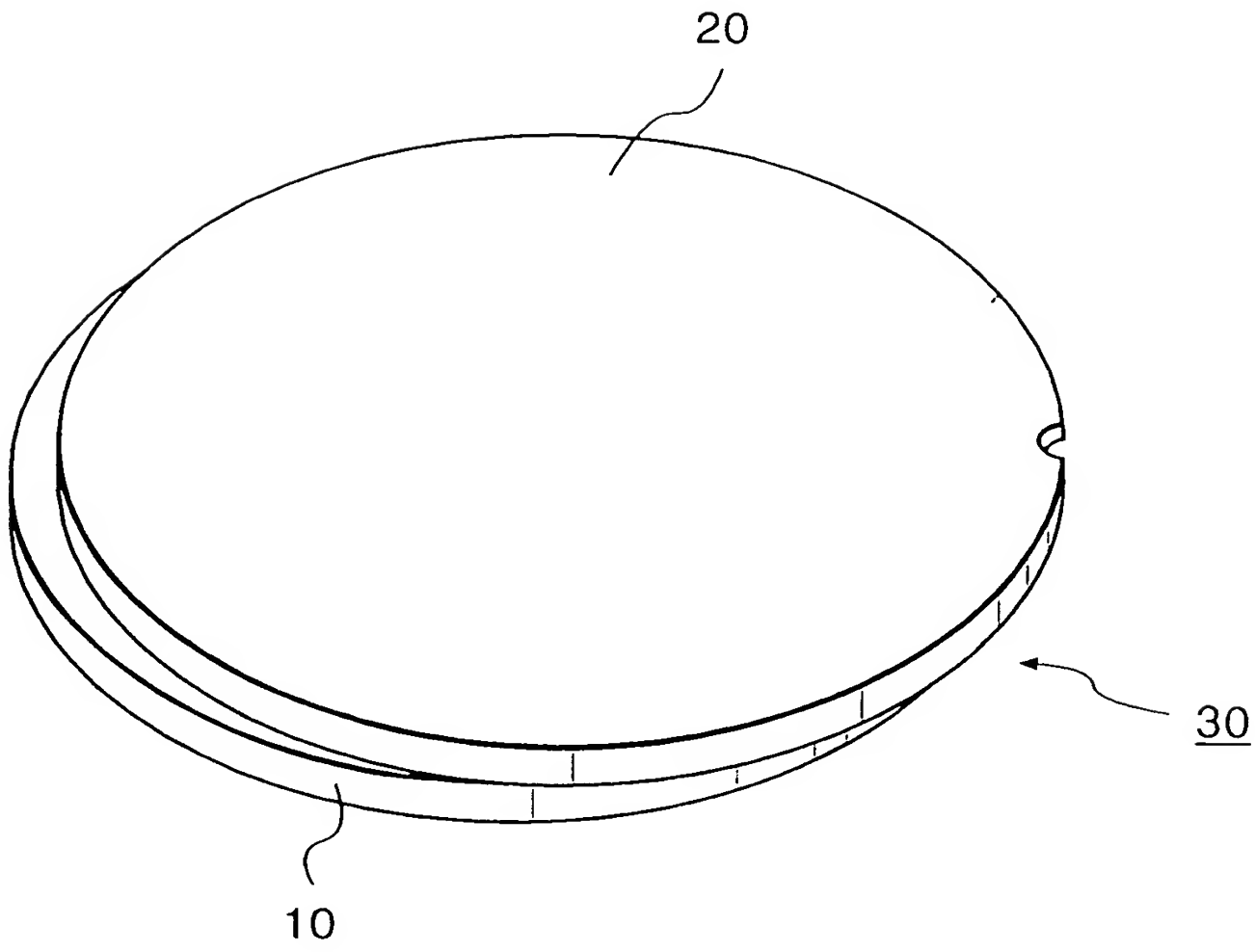


FIG. 3

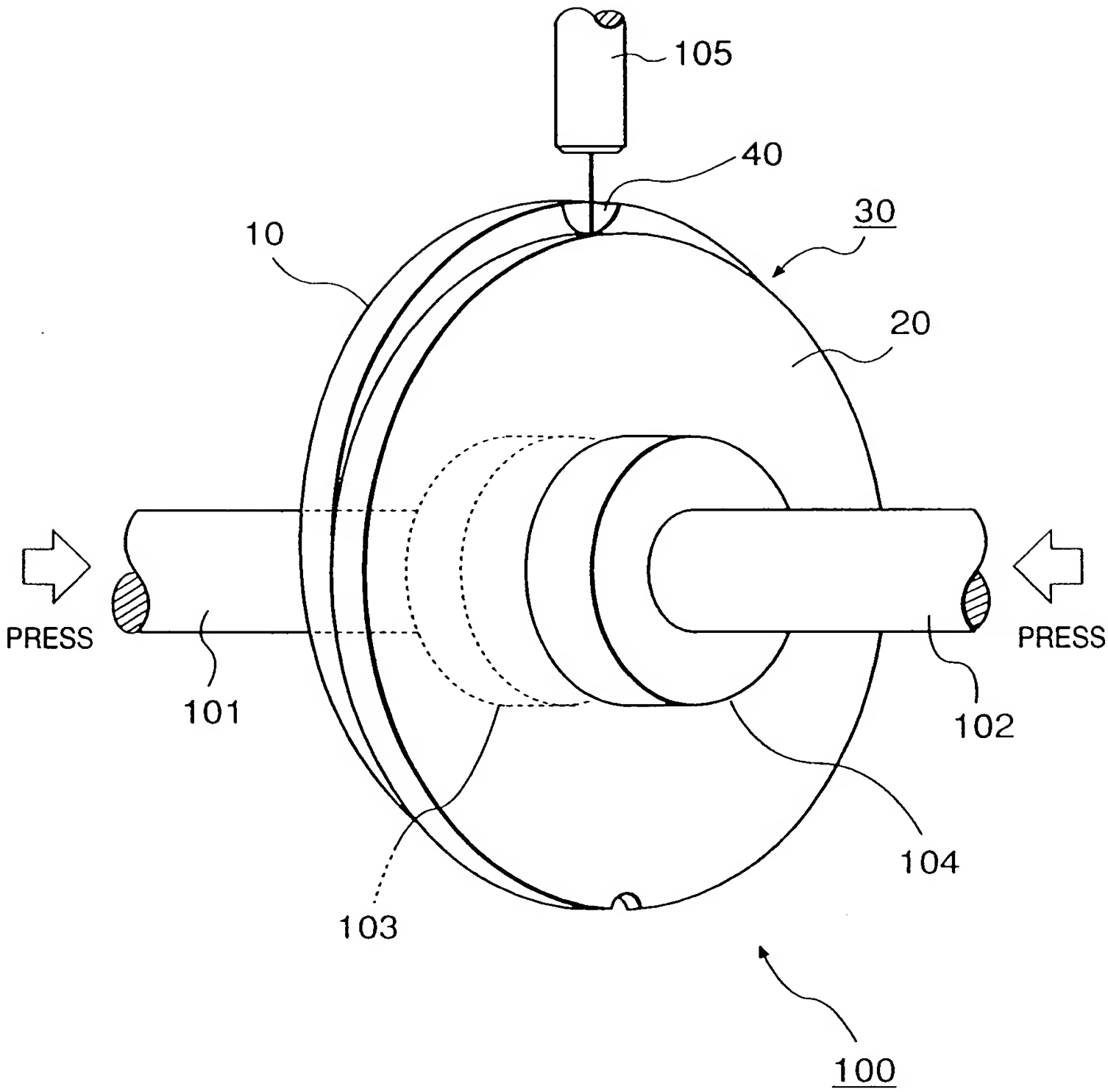


FIG. 4

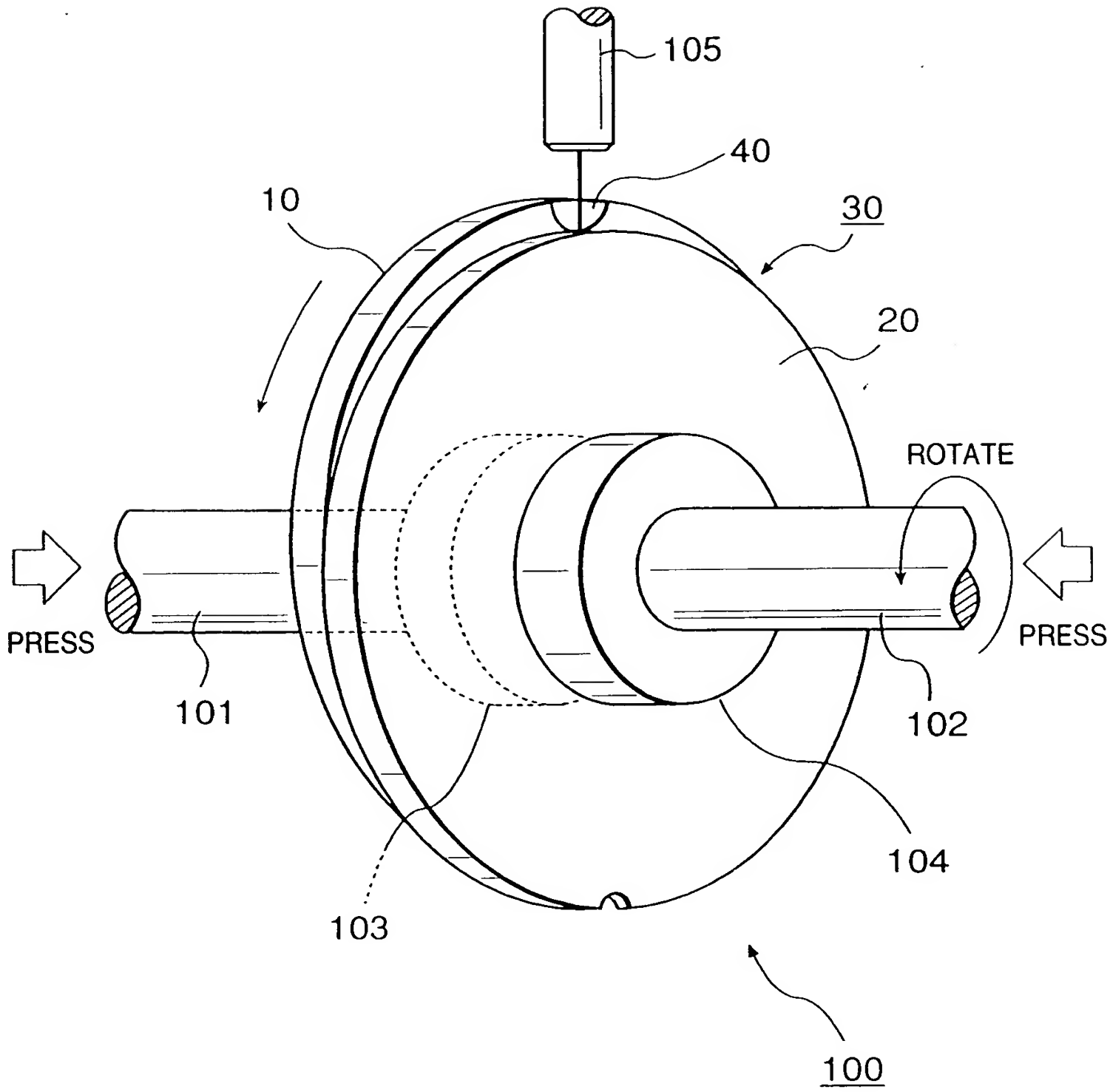
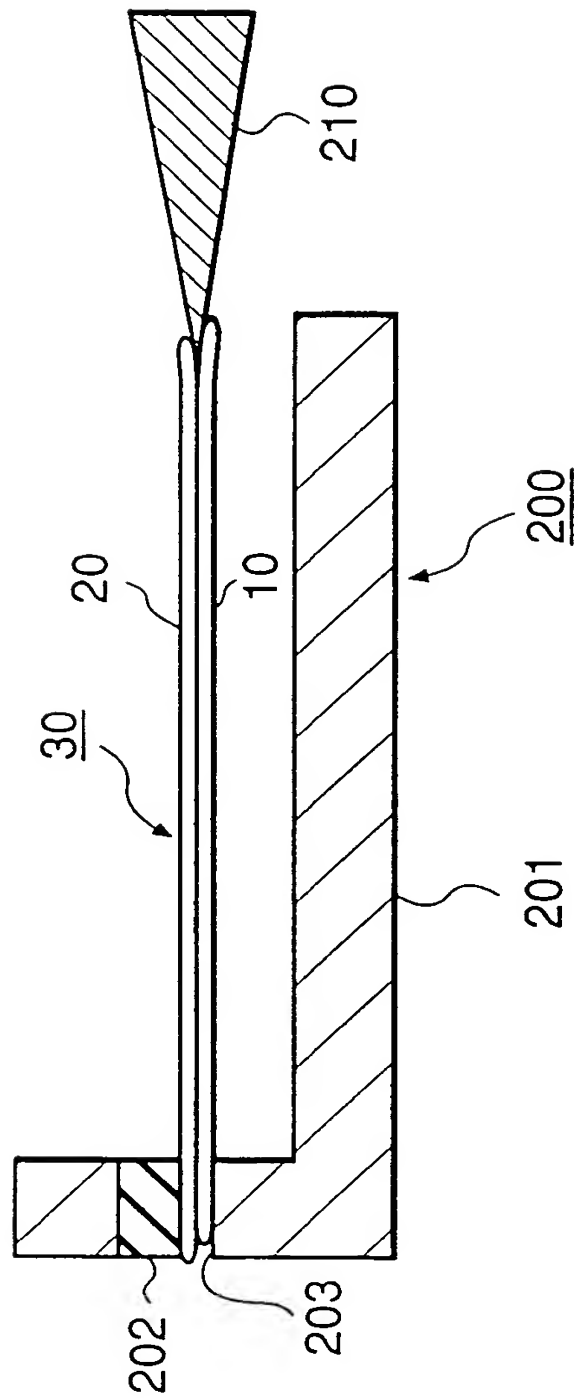


FIG. 5



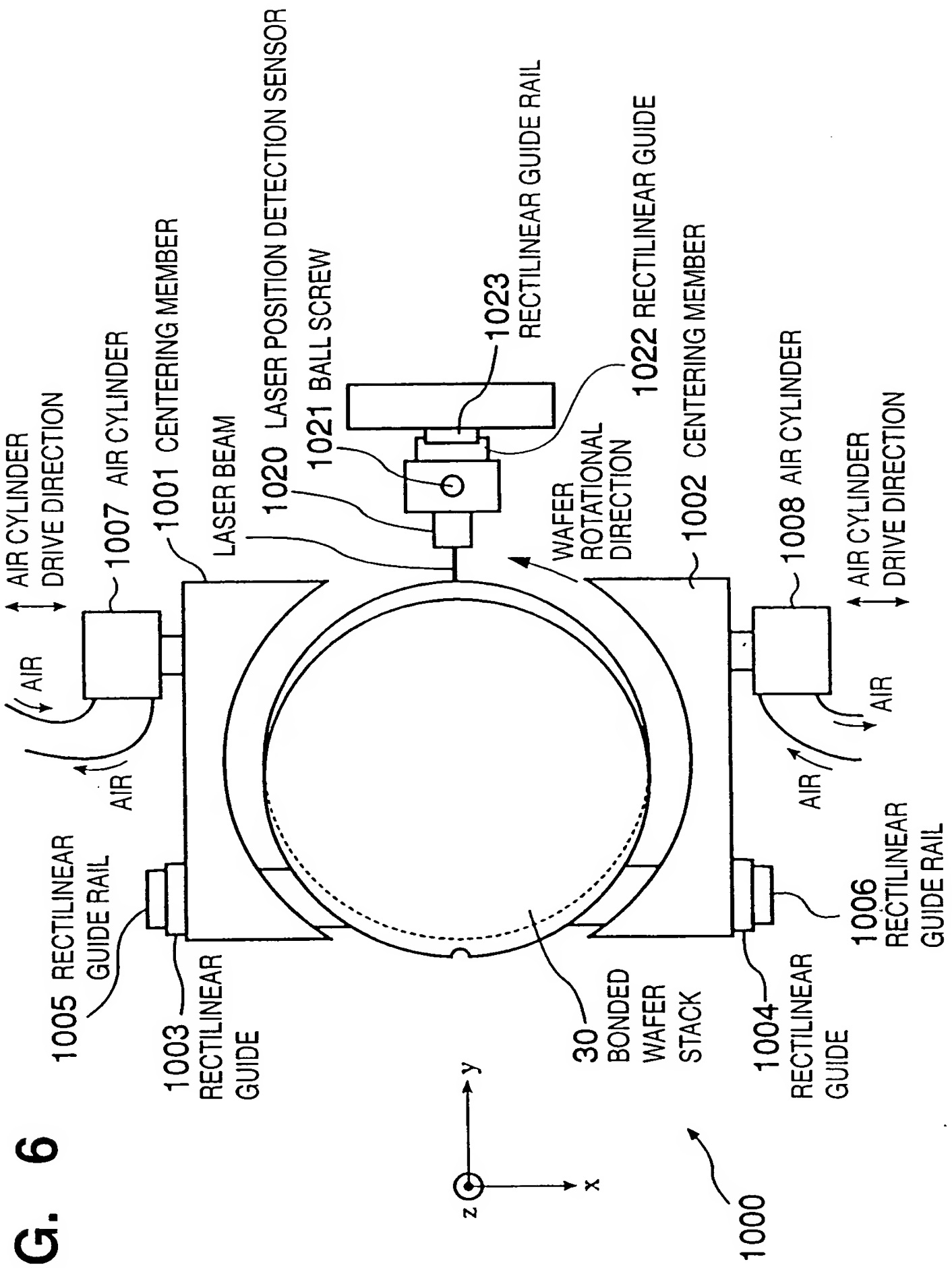

AIR CYLINDER DRIVE DIRECTION
1007 AIR CYLINDER
1001 CENTERING MEMBER
LASER BEAM
1020 LASER POSITION DETECTION SENSOR
1021 BALL SCREW
1023 RECTILINEAR GUIDE RAIL
1022 RECTILINEAR GUIDE
WAFER ROTATIONAL DIRECTION
1002 CENTERING MEMBER
1008 AIR CYLINDER
AIR CYLINDER DRIVE DIRECTION
AIR
AIR
AIR
AIR
1005 RECTILINEAR GUIDE RAIL
1003 RECTILINEAR GUIDE
30 BONDED WAFER STACK
1004 RECTILINEAR GUIDE
1006 RECTILINEAR GUIDE RAIL
y
z
x
1000

FIG. 6

FIG. 7

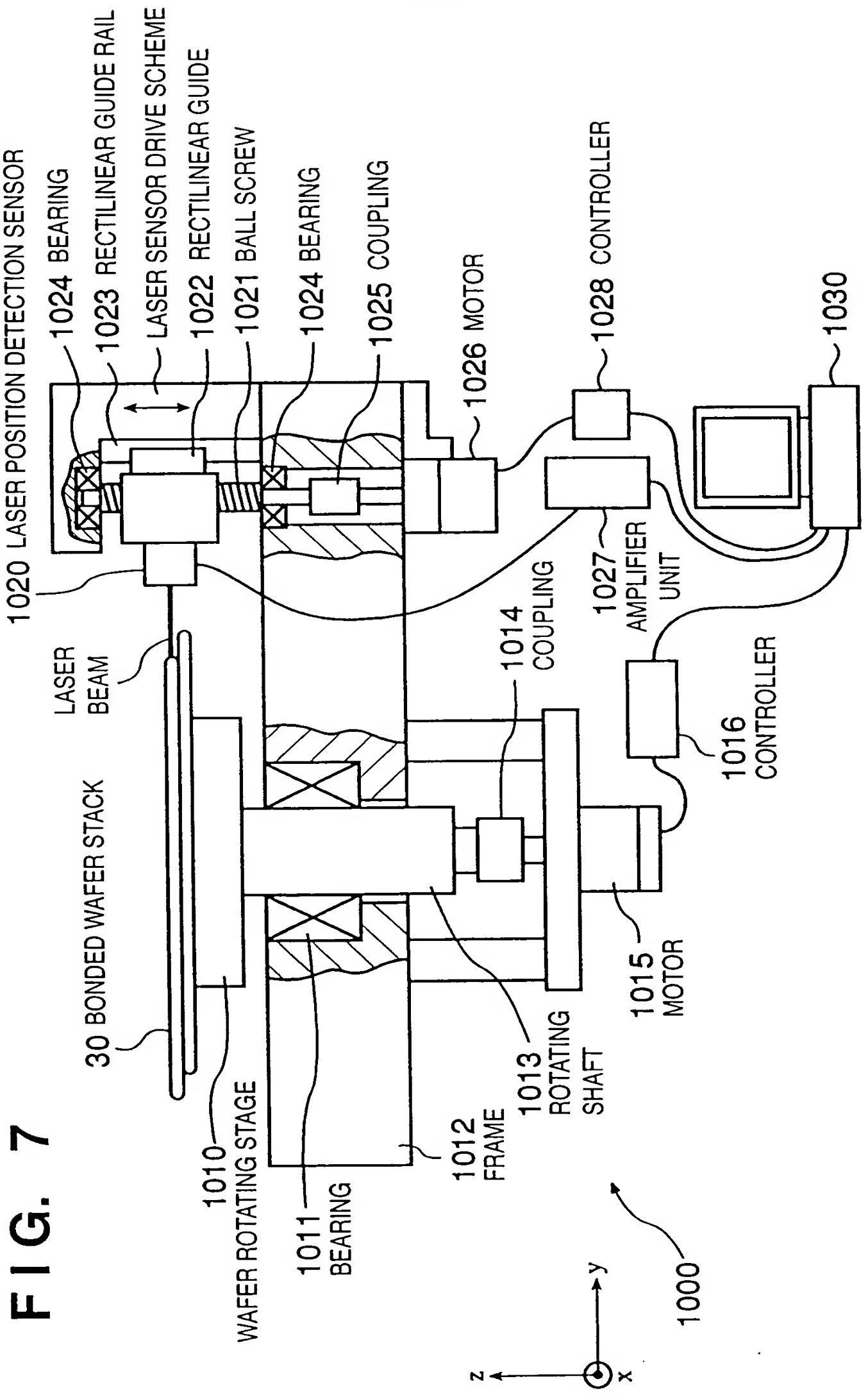

1020 LASER POSITION DETECTION SENSOR
1024 BEARING
1023 RECTILINEAR GUIDE RAIL
LASER SENSOR DRIVE SCHEME
1022 RECTILINEAR GUIDE
1021 BALL SCREW
1024 BEARING
1025 COUPLING
1026 MOTOR
1028 CONTROLLER
1030
1027 AMPLIFIER UNIT
LASER BEAM
30 BONDED WAFER STACK
1014 COUPLING
1016 CONTROLLER
1015 MOTOR
1010 WAFER ROTATING STAGE
1011 BEARING
1012 FRAME
1013 ROTATING SHAFT
1000
y
z
x

FIG. 8

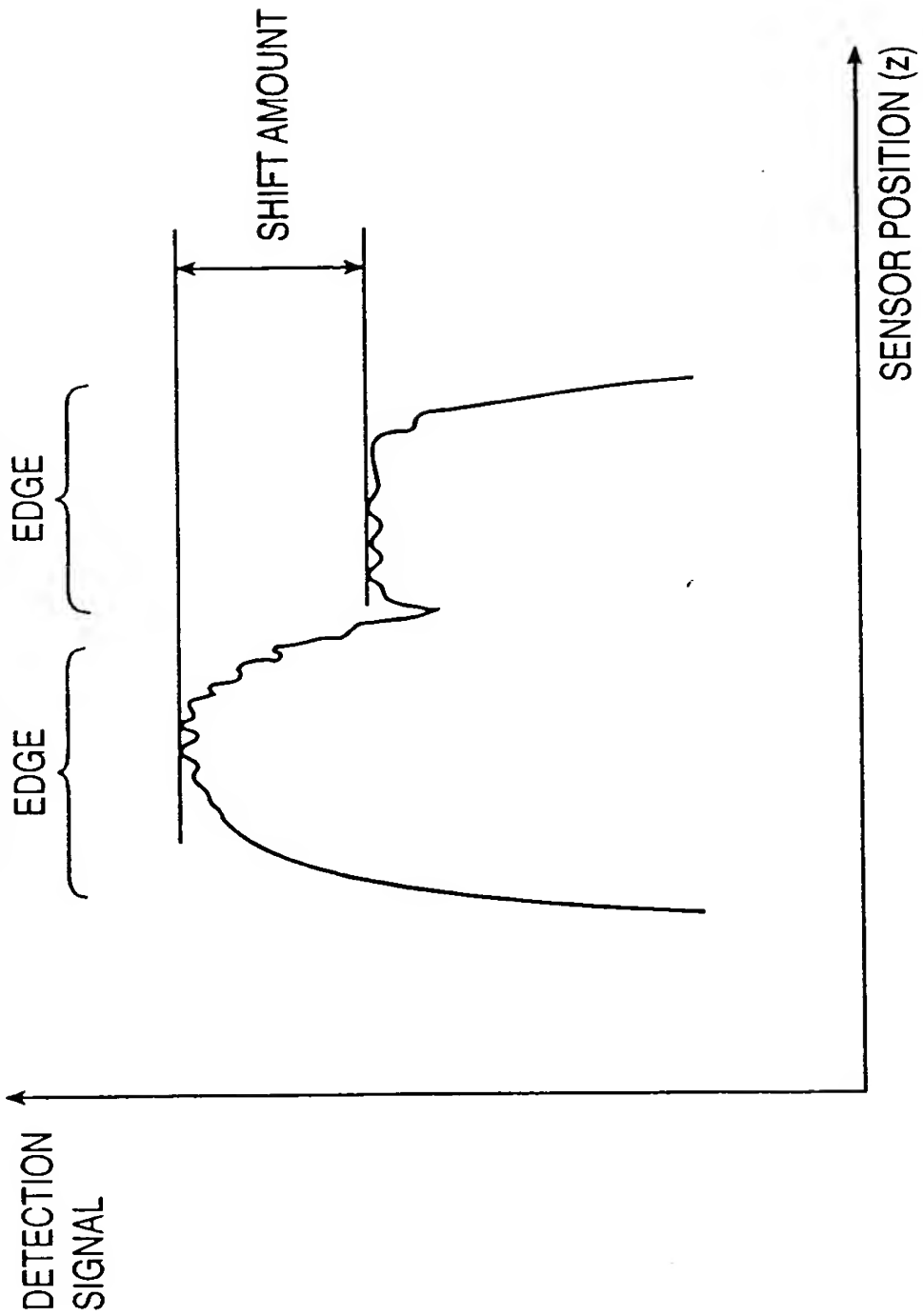

SECOND SUBSTRATE EDGE
FIRST SUBSTRATE EDGE
SHIFT AMOUNT
SENSOR POSITION (z)
DETECTION SIGNAL

FIG. 9

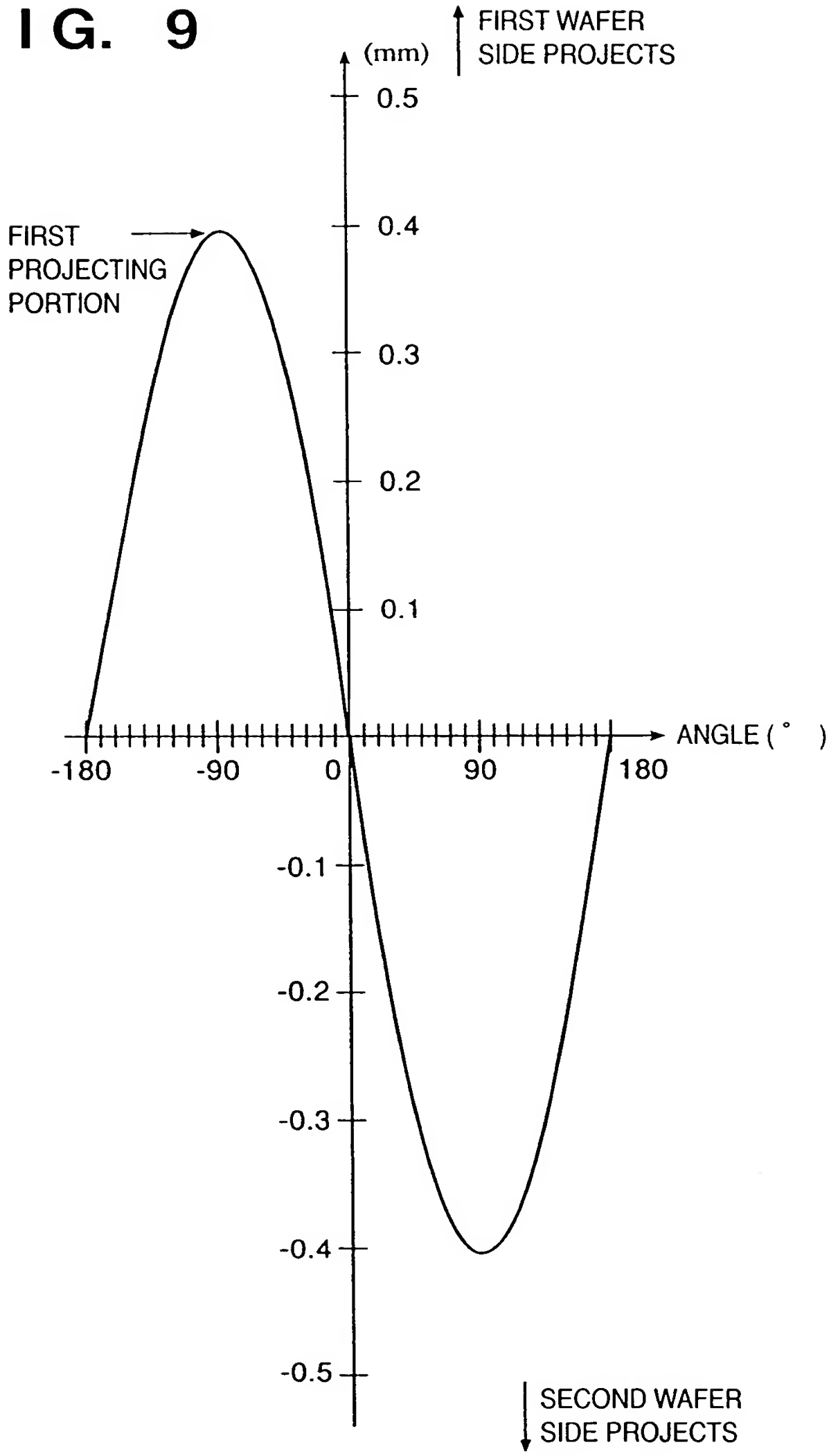

(mm)
FIRST WAFER SIDE PROJECTS
0.5
0.4
0.3
0.2
0.1
FIRST PROJECTING PORTION
ANGLE (°)
-180
-90
0
90
180
-0.1
-0.2
-0.3
-0.4
-0.5
SECOND WAFER SIDE PROJECTS

FIG. 10

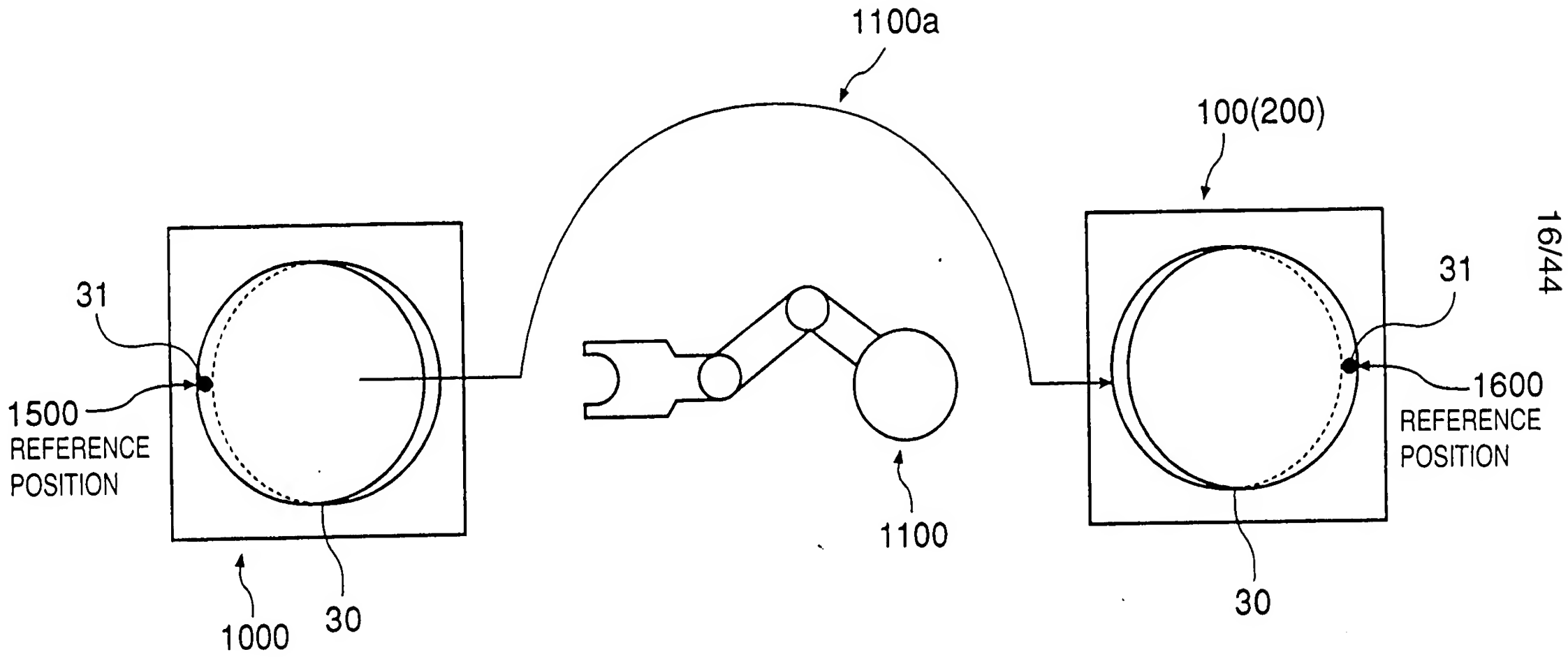
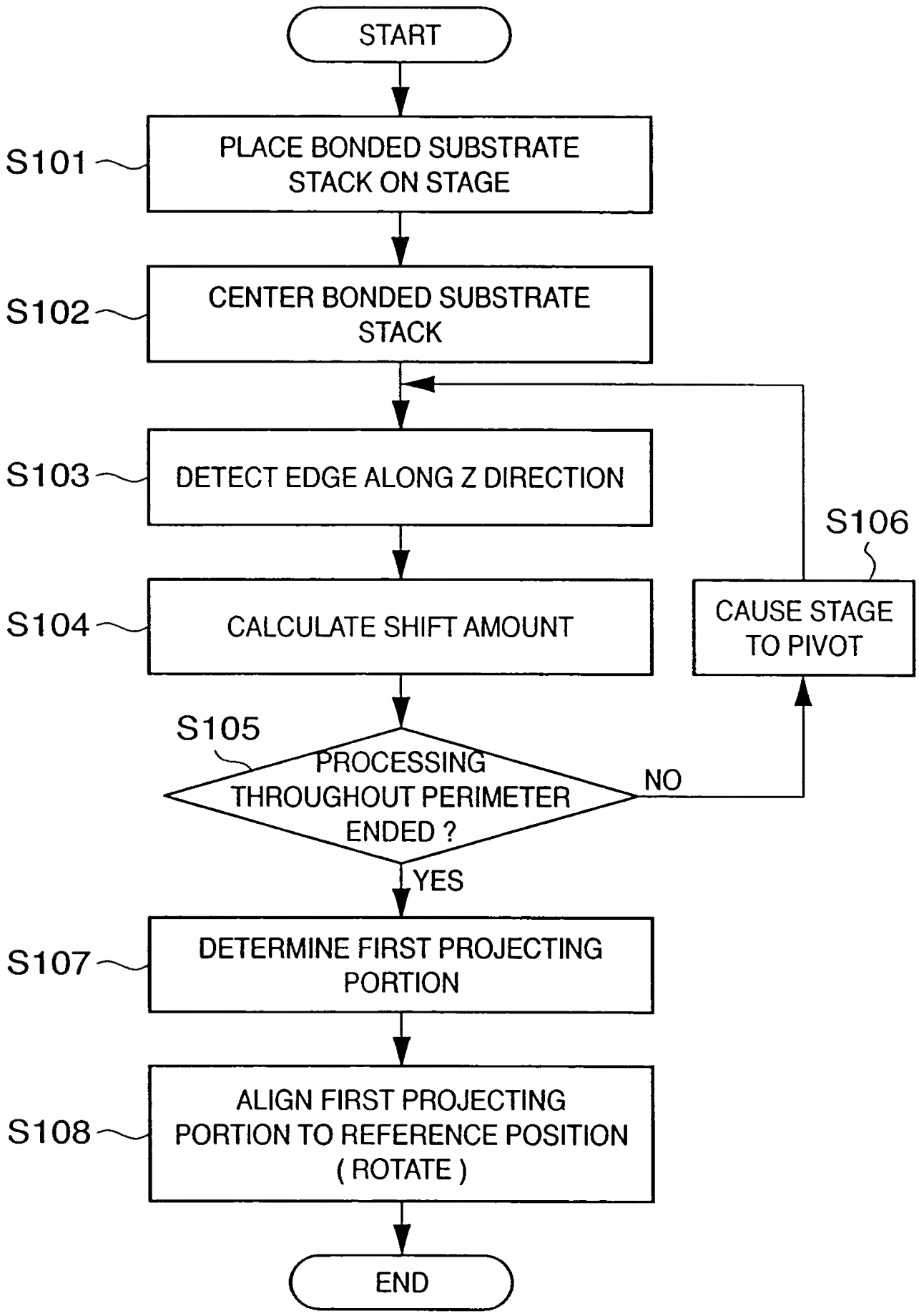

1100a
100(200)
31
1500
REFERENCE
POSITION
1000
30
1100
31
1600
REFERENCE
POSITION
30

FIG. 11


START
S101
PLACE BONDED SUBSTRATE STACK ON STAGE
S102
CENTER BONDED SUBSTRATE STACK
S103
DETECT EDGE ALONG Z DIRECTION
S104
CALCULATE SHIFT AMOUNT
S105
PROCESSING THROUGHOUT PERIMETER ENDED ?
NO
YES
S106
CAUSE STAGE TO PIVOT
S107
DETERMINE FIRST PROJECTING PORTION
S108
ALIGN FIRST PROJECTING PORTION TO REFERENCE POSITION (ROTATE)
END

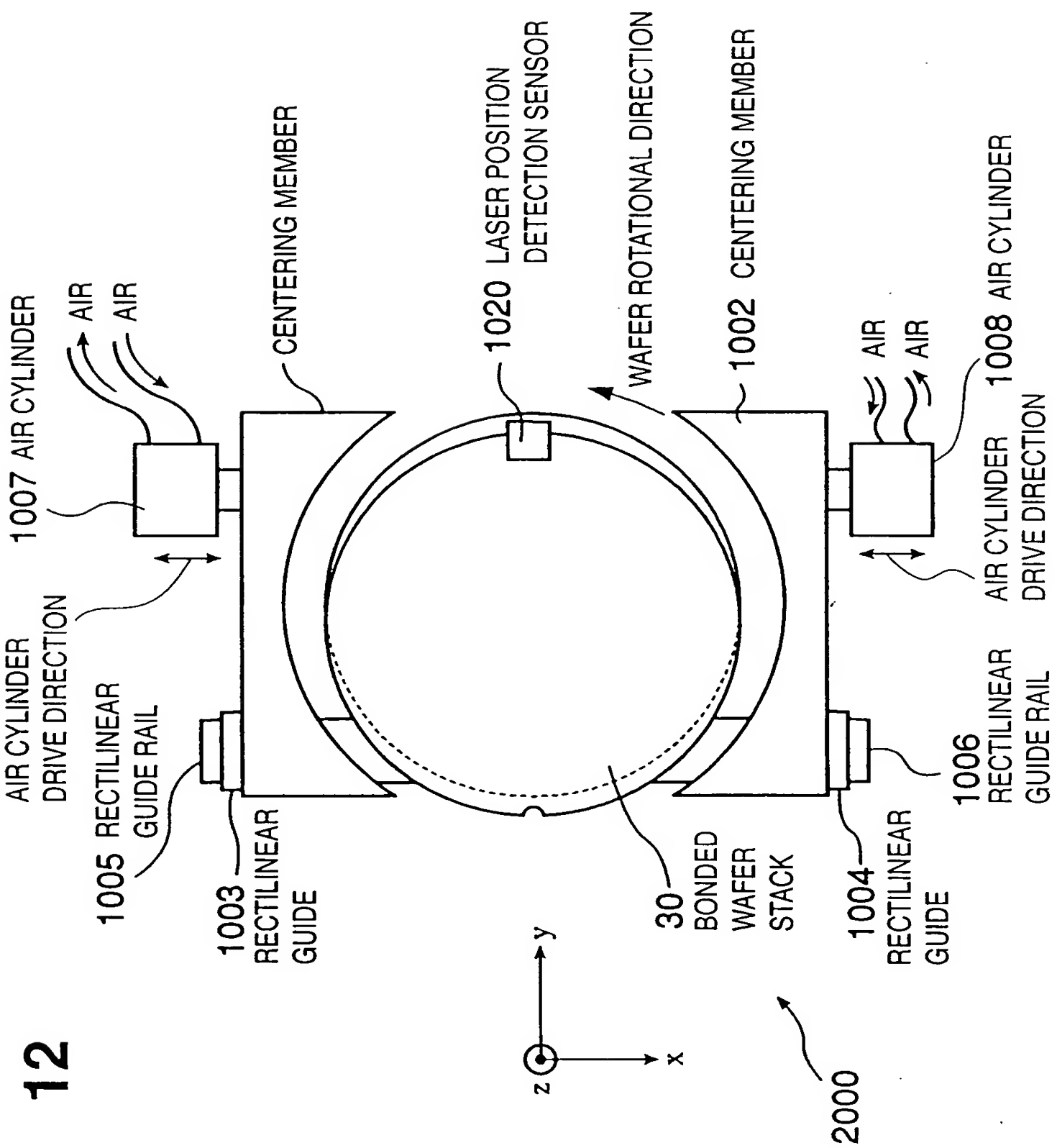

AIR CYLINDER
DRIVE DIRECTION
1007 AIR CYLINDER
AIR
AIR
CENTERING MEMBER
1020 LASER POSITION
DETECTION SENSOR
WAFER ROTATIONAL DIRECTION
1002 CENTERING MEMBER
AIR
AIR
1008 AIR CYLINDER
AIR CYLINDER
DRIVE DIRECTION
1005 RECTILINEAR
GUIDE RAIL
1003
RECTILINEAR
GUIDE
30
BONDED
WAFER
STACK
1004
RECTILINEAR
GUIDE
1006
RECTILINEAR
GUIDE RAIL
y
z
x
2000

FIG. 12

FIG. 13

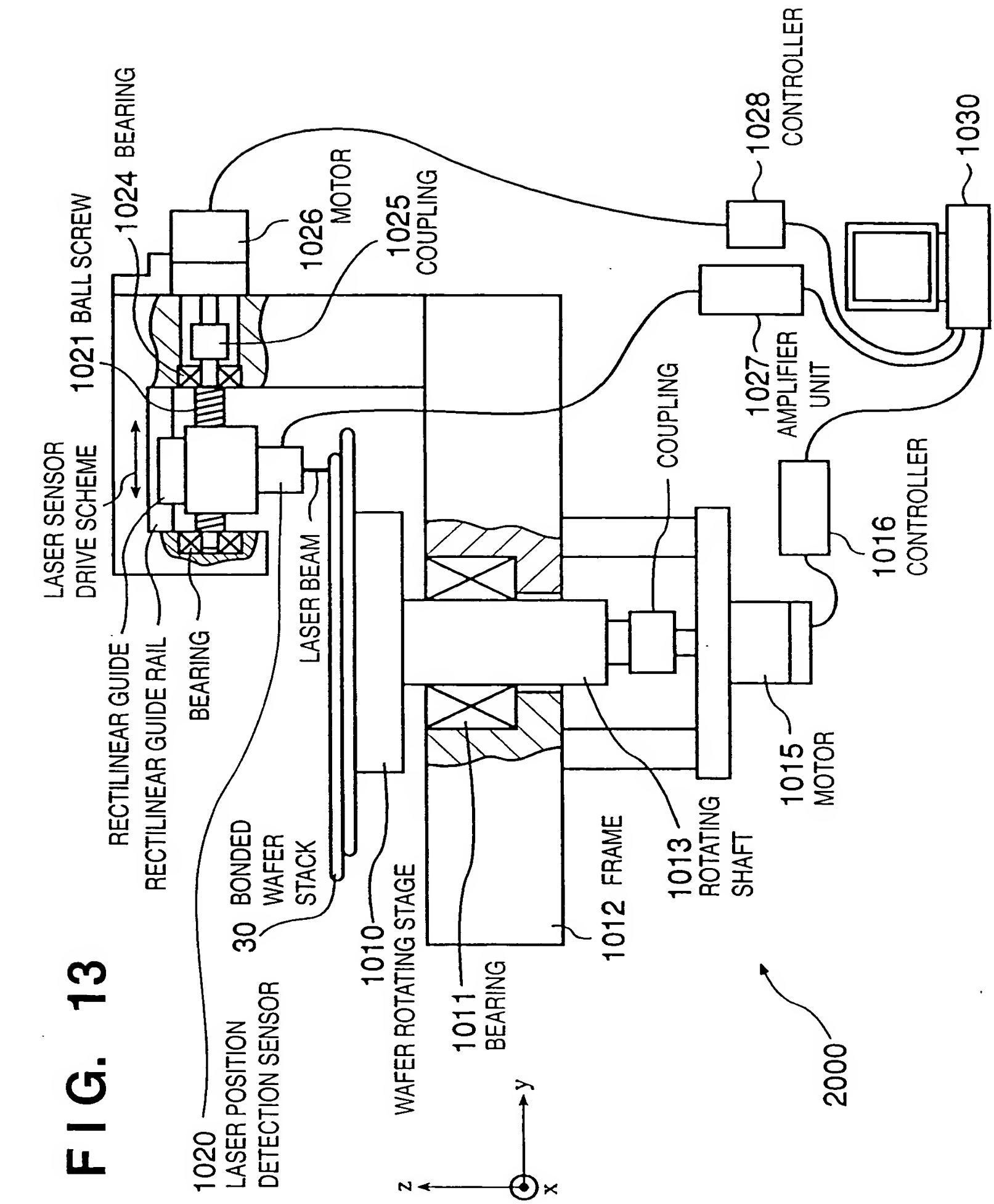

1028 CONTROLLER
1030
1024 BEARING
1021 BALL SCREW
1026 MOTOR
1025 COUPLING
LASER SENSOR DRIVE SCHEME
COUPLING
1027 AMPLIFIER UNIT
1016 CONTROLLER
RECTILINEAR GUIDE
RECTILINEAR GUIDE RAIL
BEARING
LASER BEAM
1020 LASER POSITION DETECTION SENSOR
30 BONDED WAFER STACK
1010 WAFER ROTATING STAGE
1011 BEARING
1012 FRAME
1013 ROTATING SHAFT
1015 MOTOR
2000
y
z
x

FIG. 14

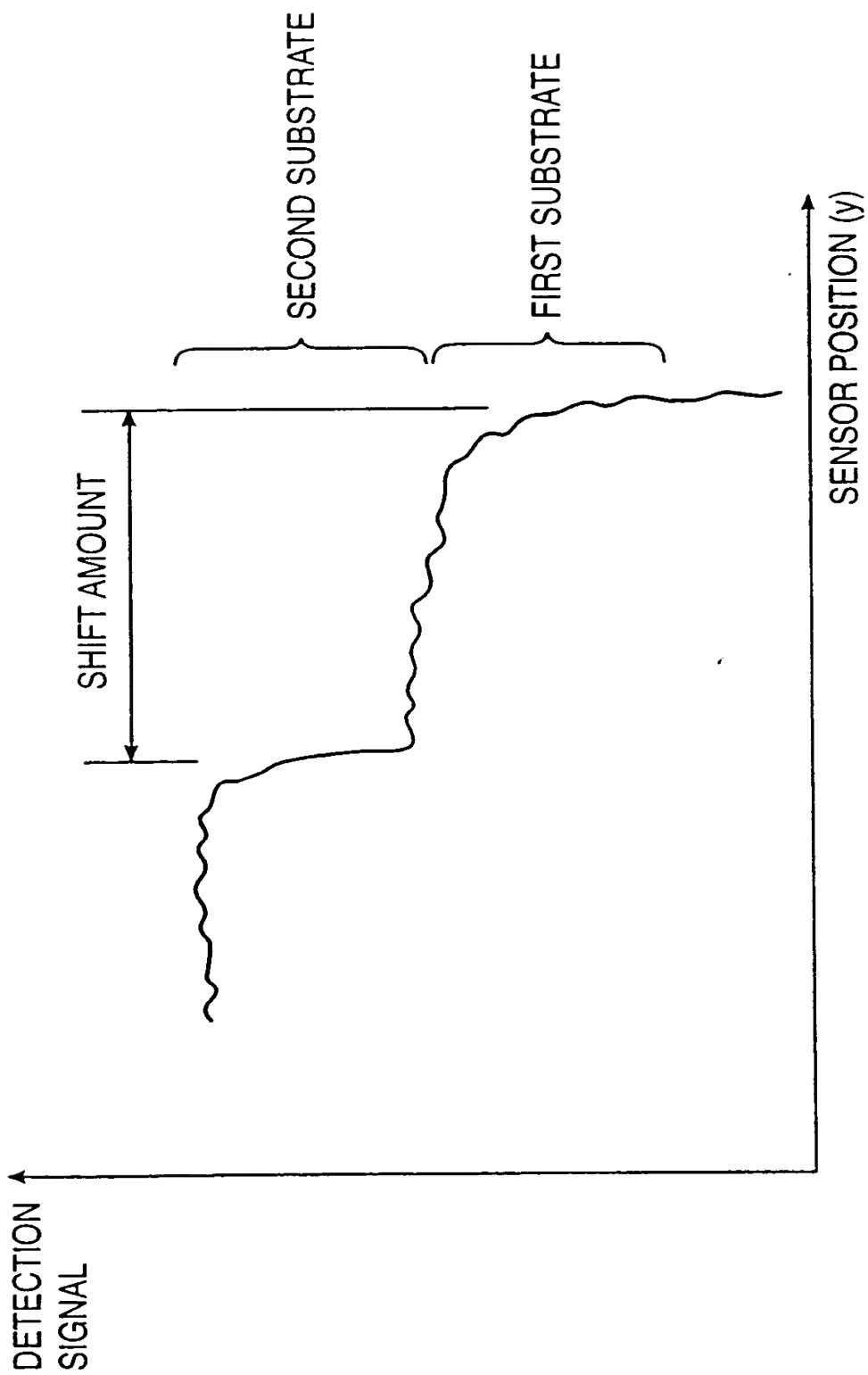

SECOND SUBSTRATE
FIRST SUBSTRATE
SHIFT AMOUNT
SENSOR POSITION (y)
DETECTION SIGNAL

FIG. 15

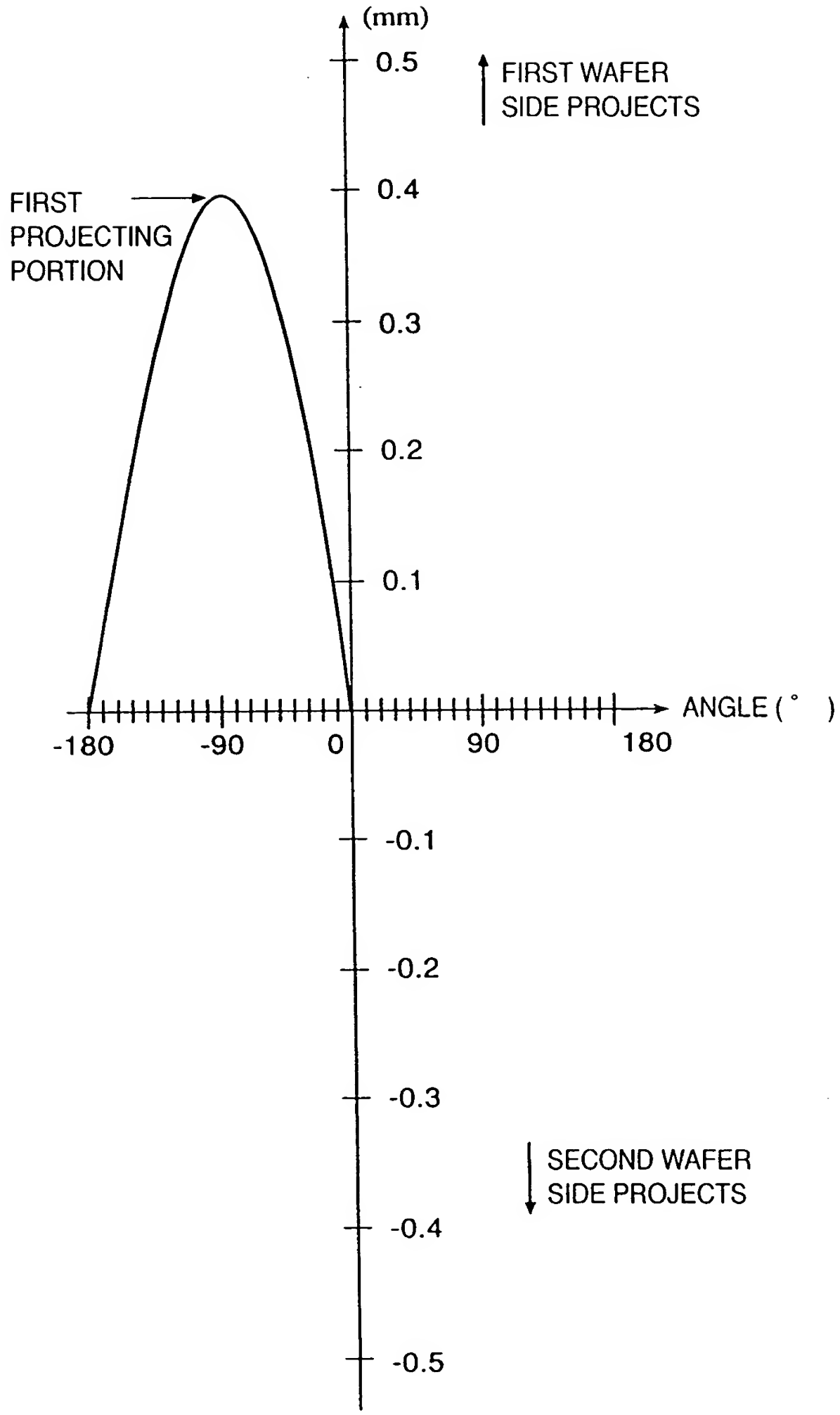
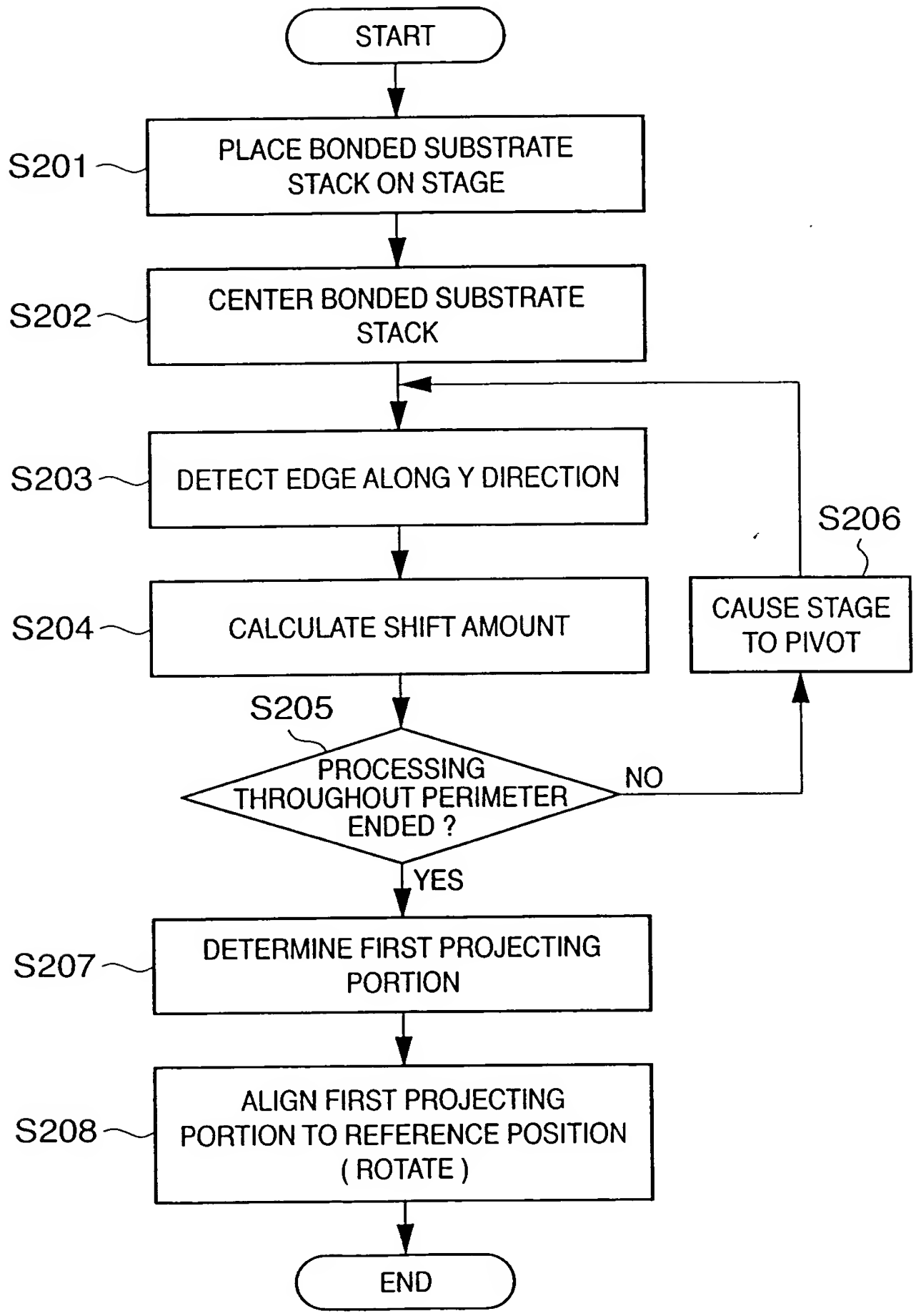

(mm)
0.5
0.4
0.3
0.2
0.1
-0.1
-0.2
-0.3
-0.4
-0.5
FIRST WAFER SIDE PROJECTS
SECOND WAFER SIDE PROJECTS
FIRST PROJECTING PORTION
-180
-90
0
90
180
ANGLE (°)

FIG. 16


START
S201
PLACE BONDED SUBSTRATE STACK ON STAGE
S202
CENTER BONDED SUBSTRATE STACK
S203
DETECT EDGE ALONG Y DIRECTION
S204
CALCULATE SHIFT AMOUNT
S205
PROCESSING THROUGHOUT PERIMETER ENDED ?
NO
YES
S206
CAUSE STAGE TO PIVOT
S207
DETERMINE FIRST PROJECTING PORTION
S208
ALIGN FIRST PROJECTING PORTION TO REFERENCE POSITION (ROTATE)
END

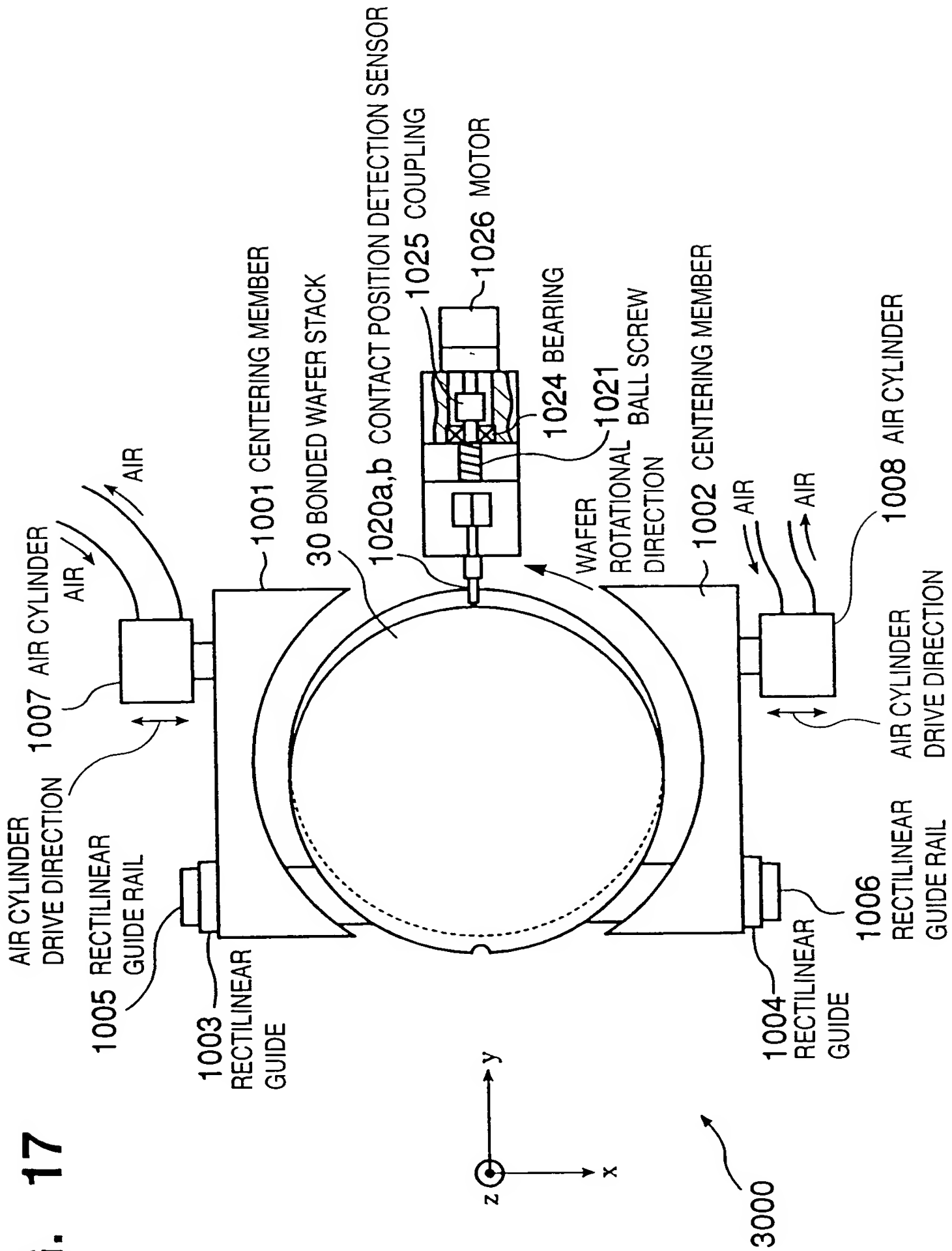

1007 AIR CYLINDER
AIR
AIR
AIR CYLINDER DRIVE DIRECTION
1001 CENTERING MEMBER
30 BONDED WAFER STACK
1020a,b CONTACT POSITION DETECTION SENSOR
1025 COUPLING
1026 MOTOR
1024 BEARING
1021 BALL SCREW
WAFER ROTATIONAL DIRECTION
1002 CENTERING MEMBER
AIR
AIR
1008 AIR CYLINDER
AIR CYLINDER DRIVE DIRECTION
1005 RECTILINEAR GUIDE RAIL
1003 RECTILINEAR GUIDE
1004 RECTILINEAR GUIDE
1006 RECTILINEAR GUIDE RAIL
y
z
x
3000

FIG. 17

FIG. 18

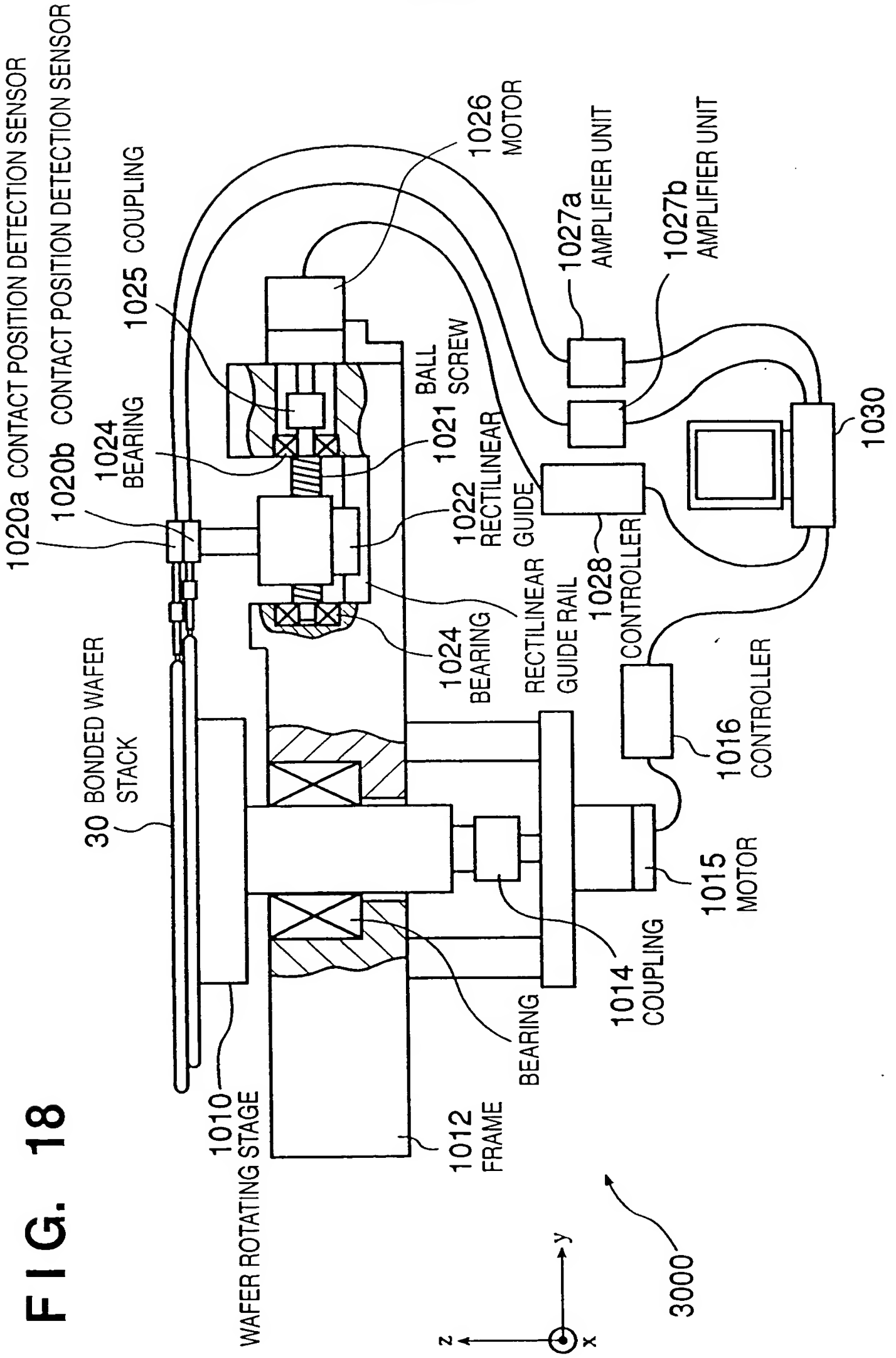

1020a CONTACT POSITION DETECTION SENSOR
1020b CONTACT POSITION DETECTION SENSOR
1024 BEARING
1025 COUPLING
1026 MOTOR
1027a AMPLIFIER UNIT
1027b AMPLIFIER UNIT
1021 BALL SCREW
1022 RECTILINEAR GUIDE
1024 BEARING
RECTILINEAR GUIDE RAIL
1028 CONTROLLER
1030
30 BONDED WAFER STACK
1010 WAFER ROTATING STAGE
1012 FRAME
BEARING
1014 COUPLING
1015 MOTOR
1016 CONTROLLER
3000
y
z
x

FIG. 19

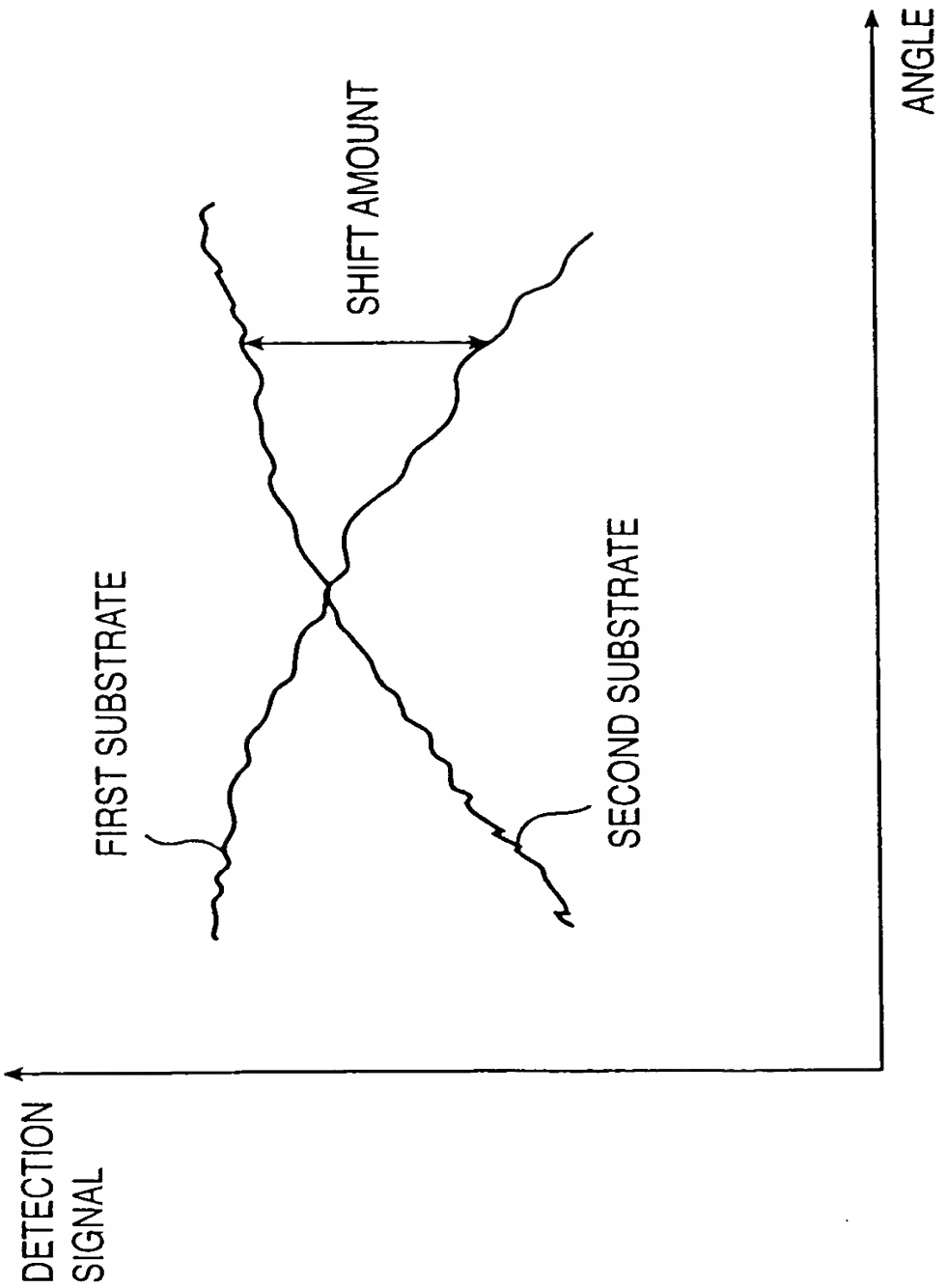

SHIFT AMOUNT
FIRST SUBSTRATE
SECOND SUBSTRATE
ANGLE
DETECTION SIGNAL

FIG. 20

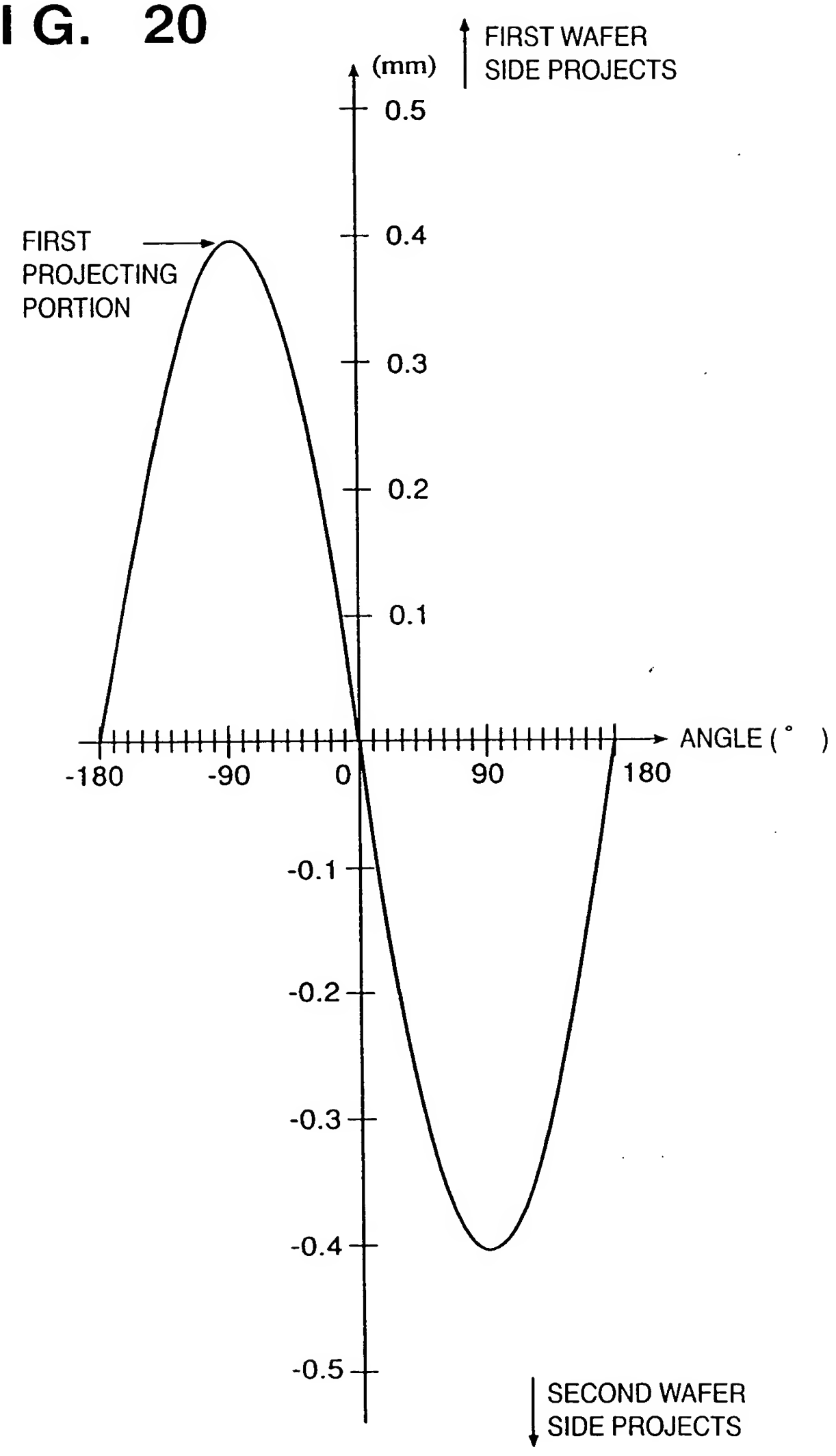

(mm)
FIRST WAFER SIDE PROJECTS
0.5
0.4
0.3
0.2
0.1
FIRST PROJECTING PORTION
-180
-90
0
90
180
ANGLE (°)
-0.1
-0.2
-0.3
-0.4
-0.5
SECOND WAFER SIDE PROJECTS

FIG. 21

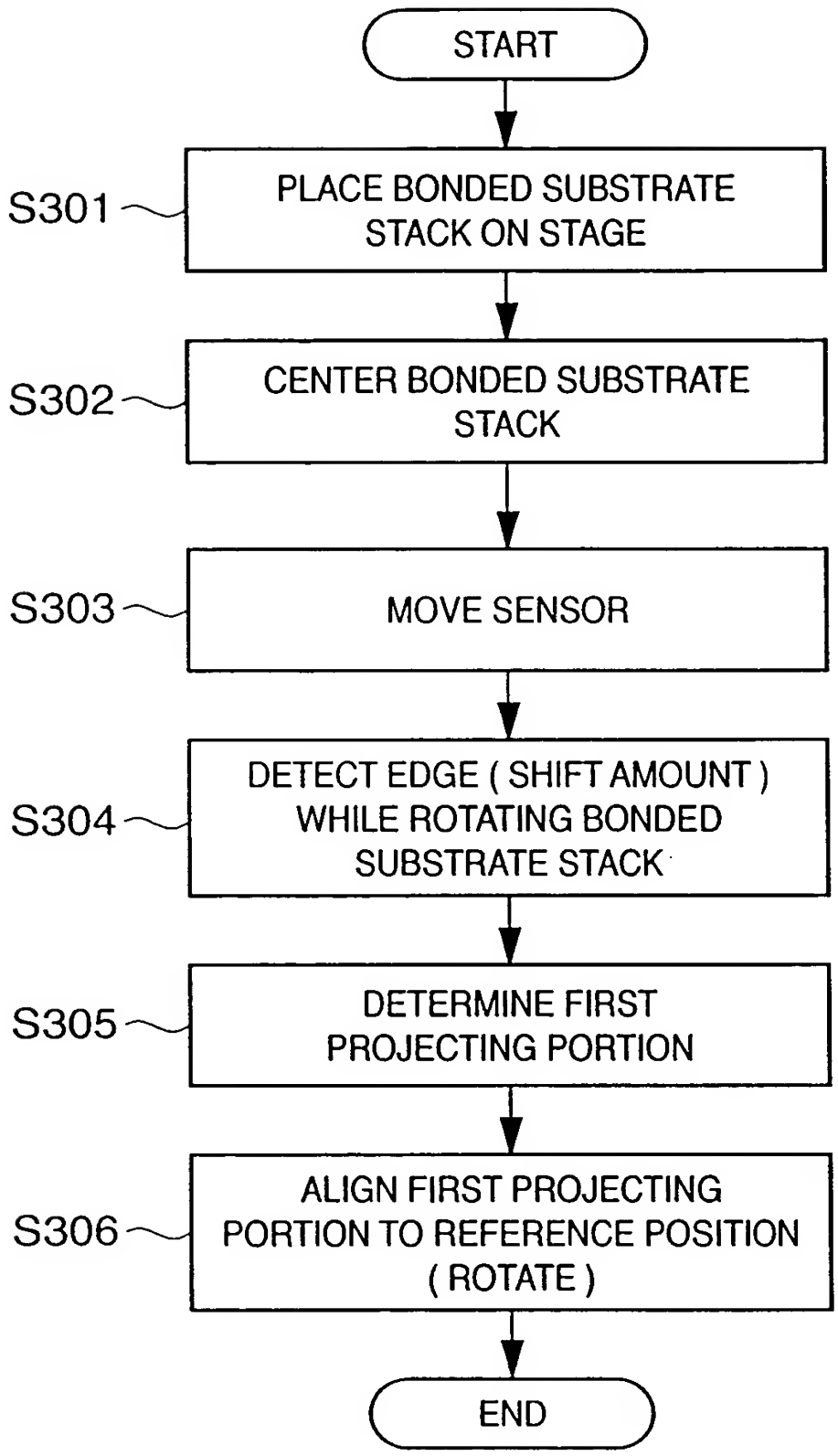

START
S301
PLACE BONDED SUBSTRATE STACK ON STAGE
S302
CENTER BONDED SUBSTRATE STACK
S303
MOVE SENSOR
S304
DETECT EDGE (SHIFT AMOUNT) WHILE ROTATING BONDED SUBSTRATE STACK
S305
DETERMINE FIRST PROJECTING PORTION
S306
ALIGN FIRST PROJECTING PORTION TO REFERENCE POSITION (ROTATE)
END

FIG. 22

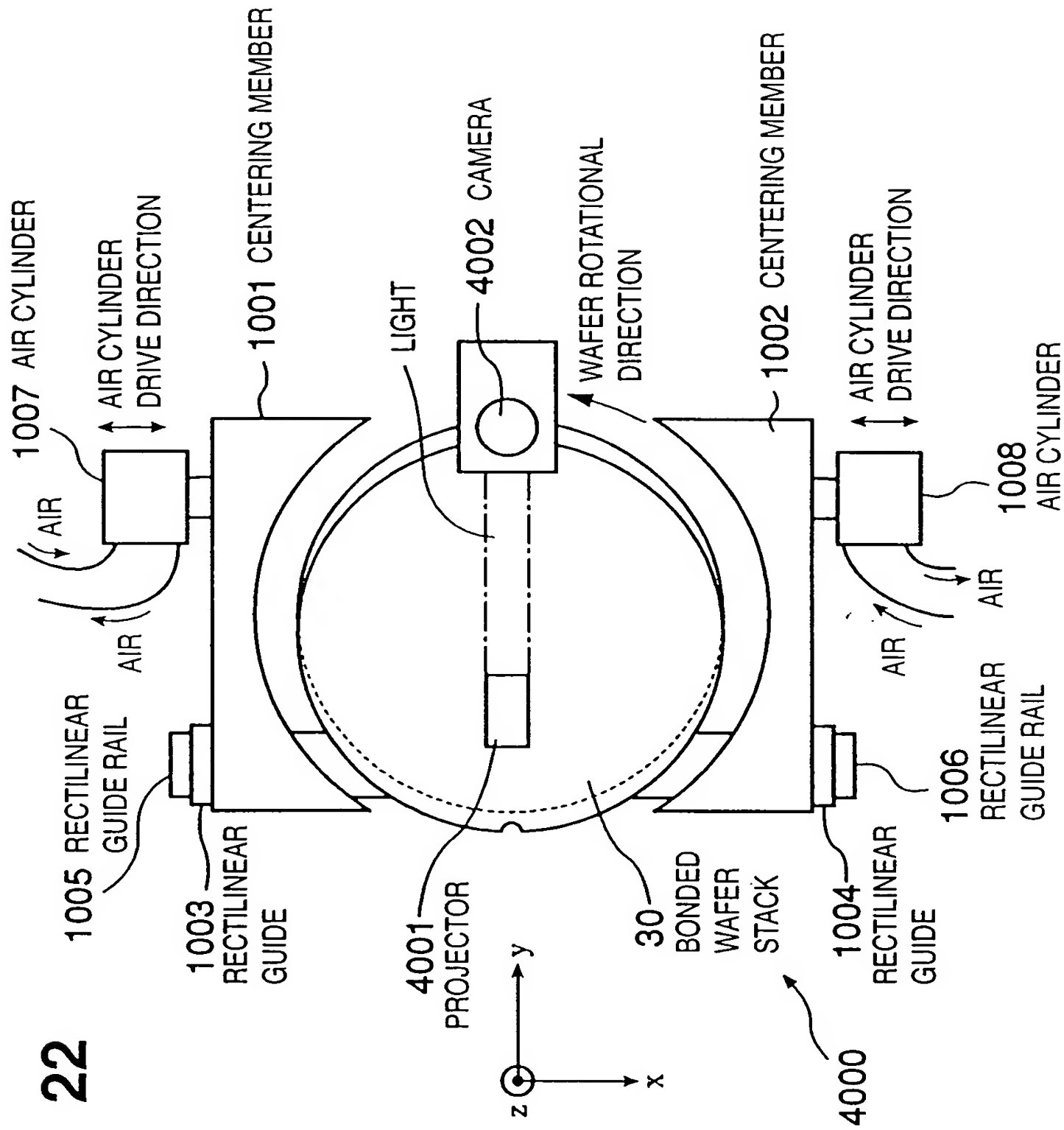

1007 AIR CYLINDER
AIR
AIR CYLINDER DRIVE DIRECTION
1001 CENTERING MEMBER
LIGHT
4002 CAMERA
WAFER ROTATIONAL DIRECTION
1002 CENTERING MEMBER
AIR CYLINDER DRIVE DIRECTION
1008 AIR CYLINDER
AIR
1005 RECTILINEAR GUIDE RAIL
1003 RECTILINEAR GUIDE
4001 PROJECTOR
30 BONDED WAFER STACK
1004 RECTILINEAR GUIDE
1006 RECTILINEAR GUIDE RAIL
4000
y
x
z

FIG. 23

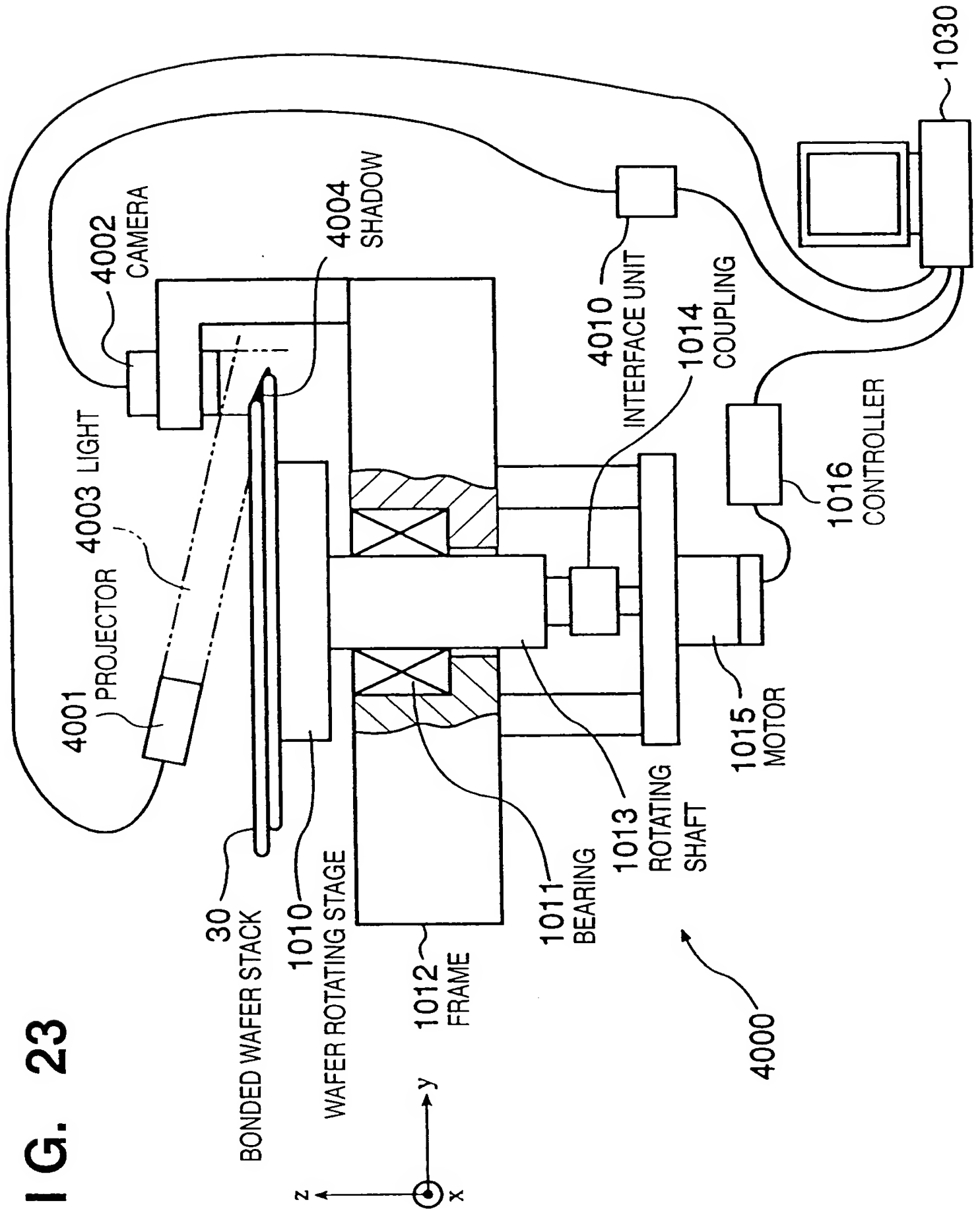

4001 PROJECTOR
4002 CAMERA
4003 LIGHT
4004 SHADOW
4010 INTERFACE UNIT
1014 COUPLING
1030
1016 CONTROLLER
30 BONDED WAFER STACK
1010 WAFER ROTATING STAGE
1012 FRAME
1011 BEARING
1013 ROTATING SHAFT
1015 MOTOR
4000
z
y
x

FIG. 24

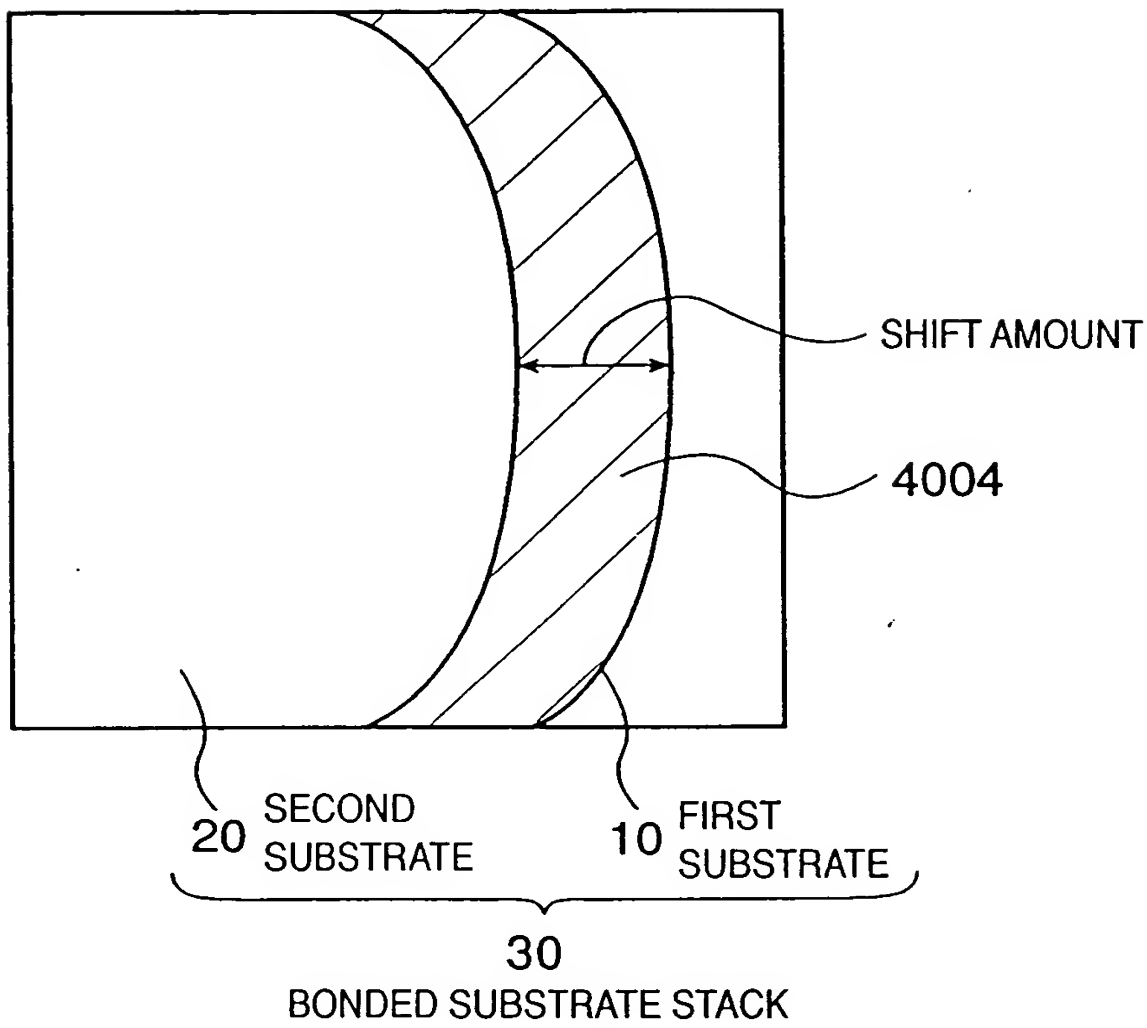

SHIFT AMOUNT
4004
20 SECOND SUBSTRATE
10 FIRST SUBSTRATE
30
BONDED SUBSTRATE STACK

FIG. 25

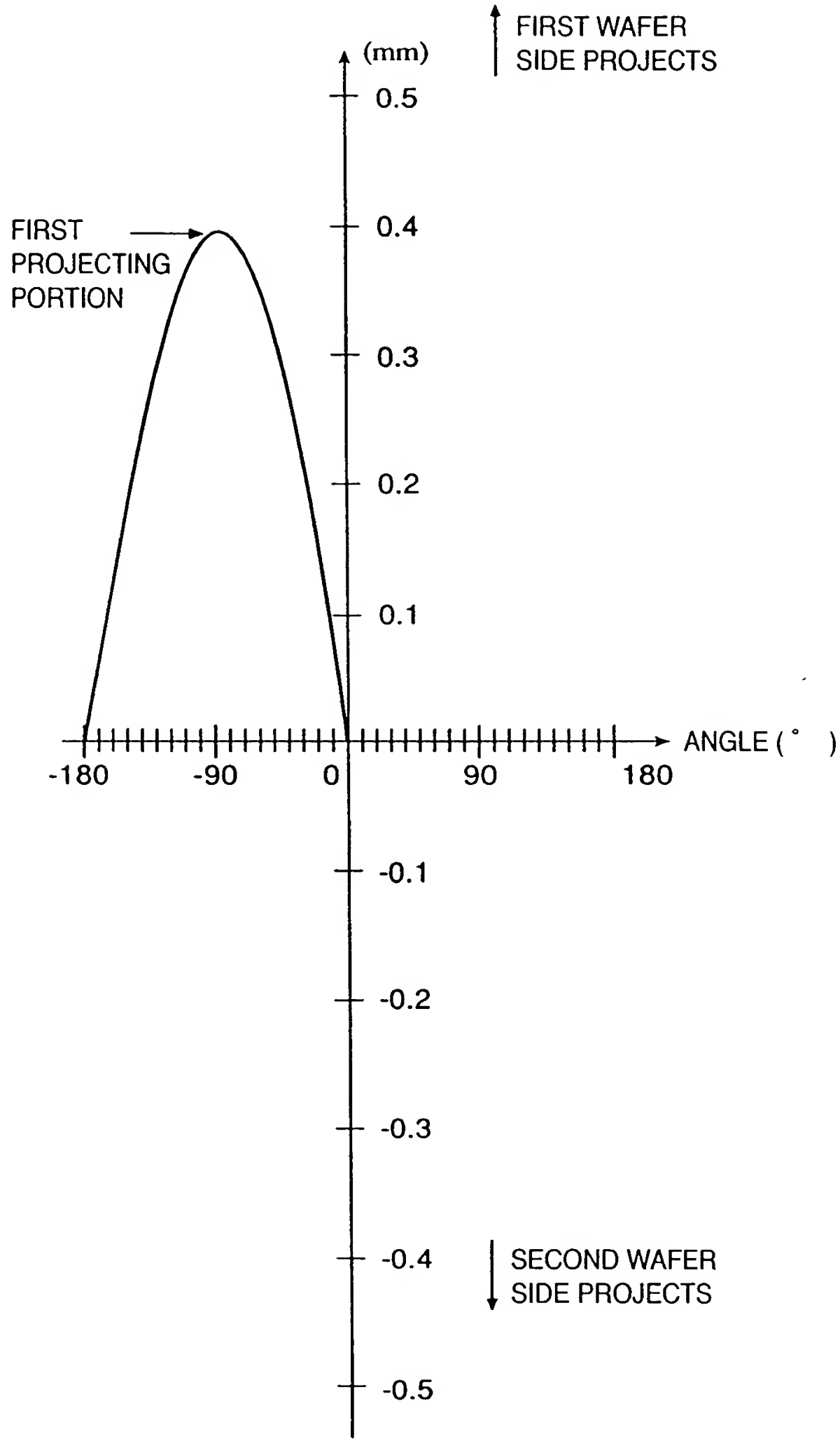
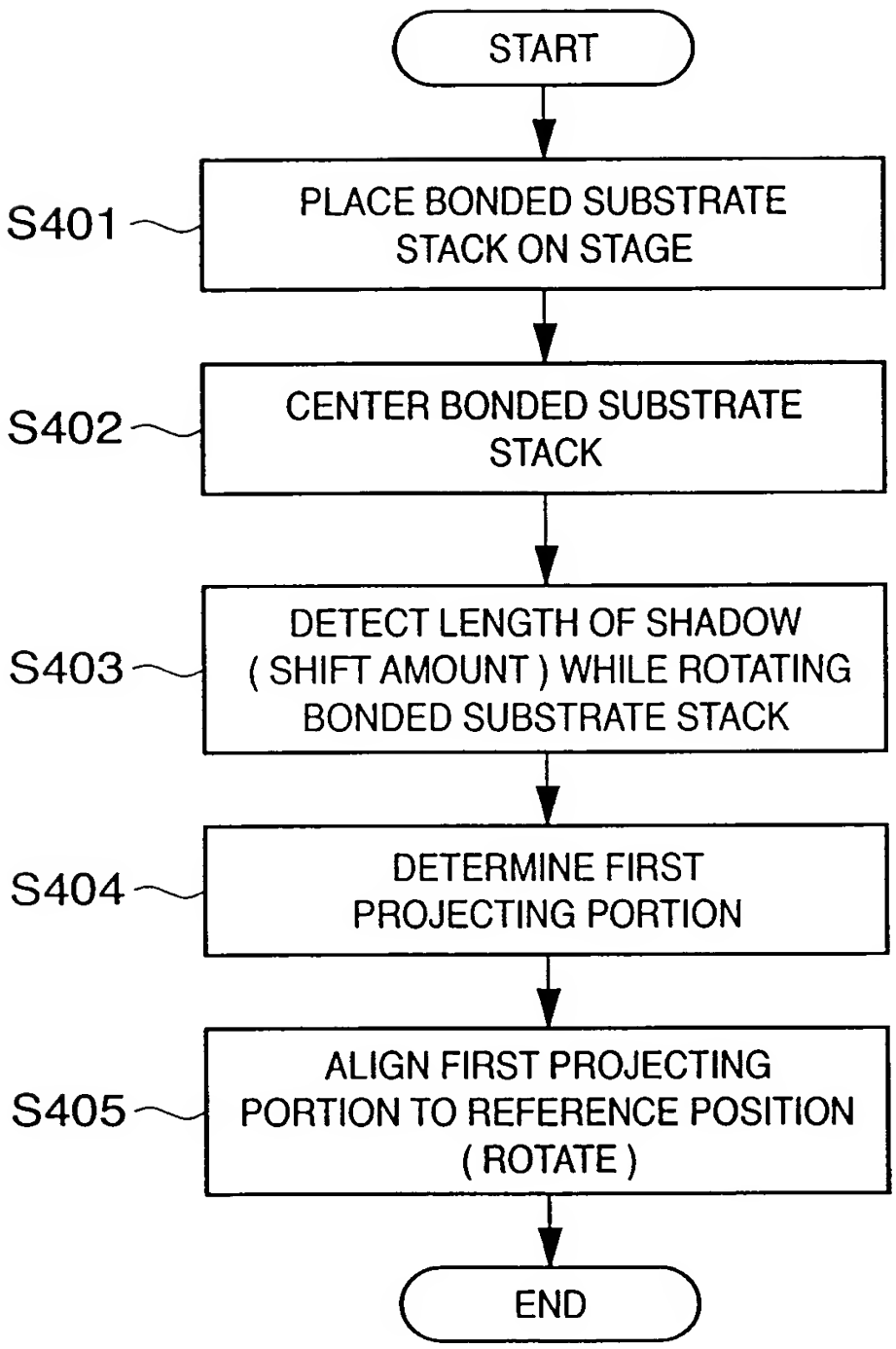

FIRST WAFER
SIDE PROJECTS
(mm)
0.5
0.4
0.3
0.2
0.1
FIRST
PROJECTING
PORTION
ANGLE (°)
-180
-90
0
90
180
-0.1
-0.2
-0.3
-0.4
-0.5
SECOND WAFER
SIDE PROJECTS

FIG. 26


START
S401
PLACE BONDED SUBSTRATE STACK ON STAGE
S402
CENTER BONDED SUBSTRATE STACK
S403
DETECT LENGTH OF SHADOW (SHIFT AMOUNT) WHILE ROTATING BONDED SUBSTRATE STACK
S404
DETERMINE FIRST PROJECTING PORTION
S405
ALIGN FIRST PROJECTING PORTION TO REFERENCE POSITION (ROTATE)
END

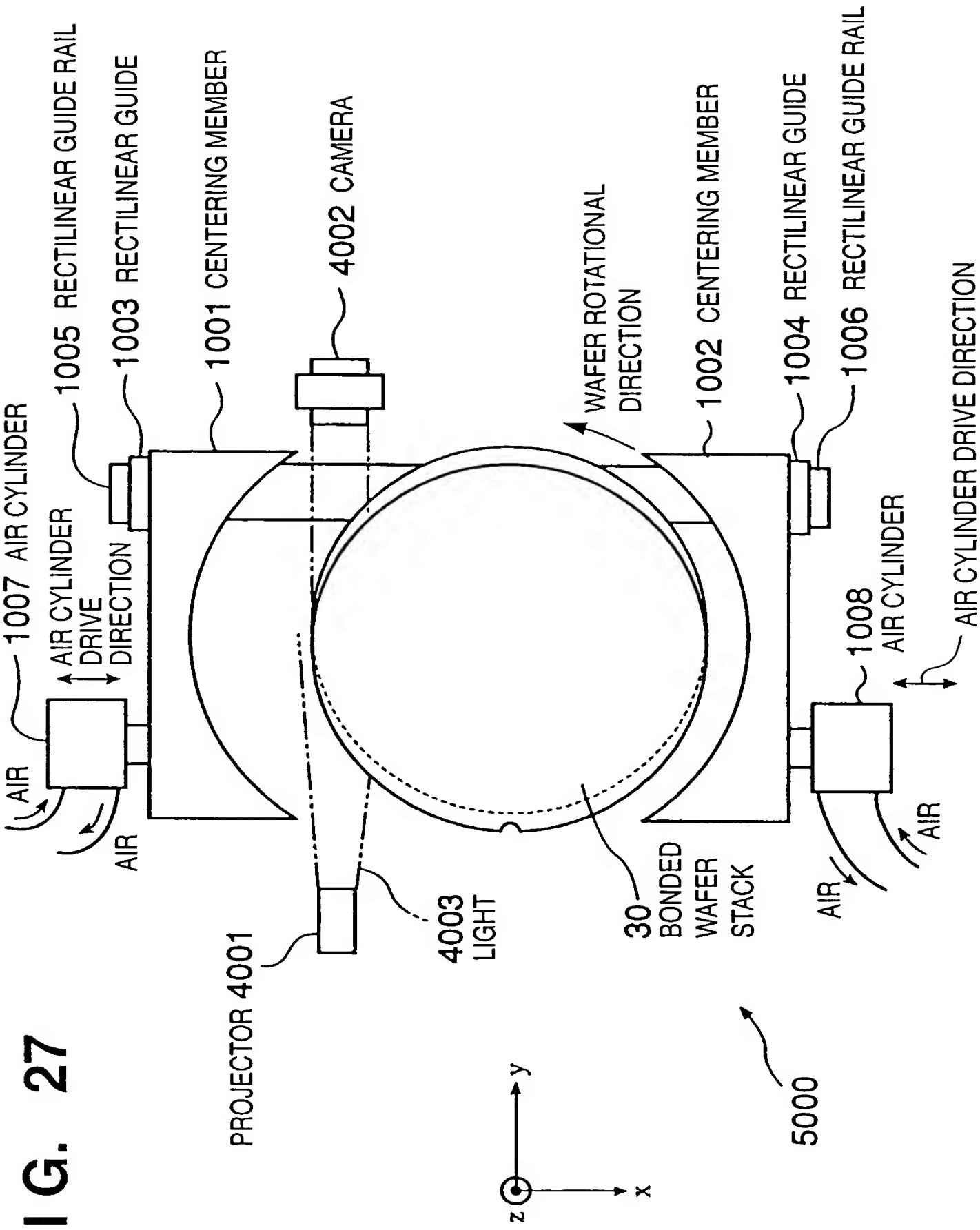

1007 AIR CYLINDER
AIR CYLINDER DRIVE DIRECTION
1005 RECTILINEAR GUIDE RAIL
1003 RECTILINEAR GUIDE
1001 CENTERING MEMBER
4002 CAMERA
WAFER ROTATIONAL DIRECTION
1002 CENTERING MEMBER
1004 RECTILINEAR GUIDE
1006 RECTILINEAR GUIDE RAIL
1008 AIR CYLINDER
AIR CYLINDER DRIVE DIRECTION
AIR
AIR
PROJECTOR 4001
4003 LIGHT
30 BONDED WAFER STACK
AIR
AIR
5000
y
z
x

FIG. 27

FIG. 28

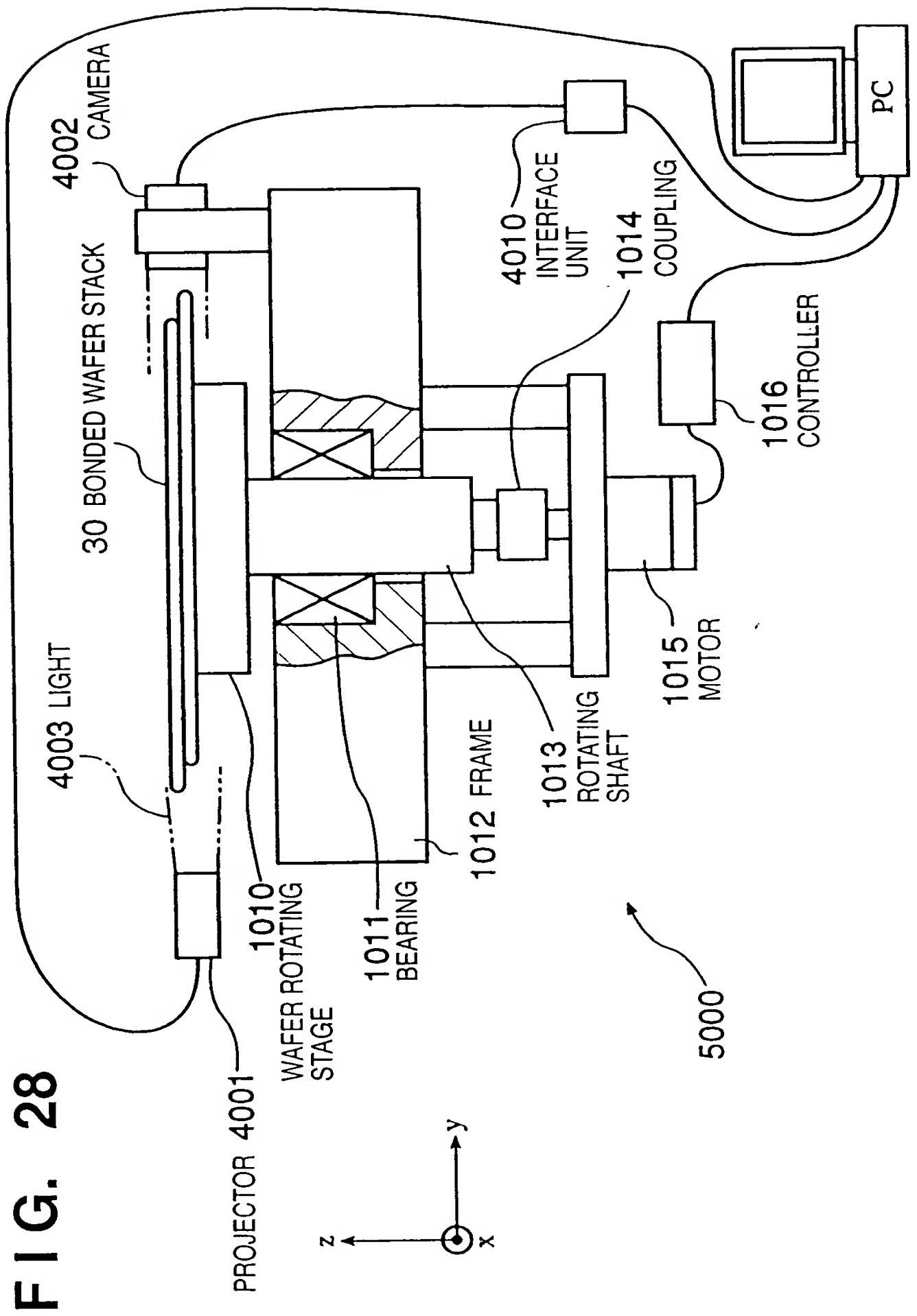

4002 CAMERA
30 BONDED WAFER STACK
4003 LIGHT
PROJECTOR 4001
1010 WAFER ROTATING STAGE
1011 BEARING
1012 FRAME
1013 ROTATING SHAFT
1014 COUPLING
1015 MOTOR
1016 CONTROLLER
4010 INTERFACE UNIT
PC
5000
z
y
x

FIG. 29

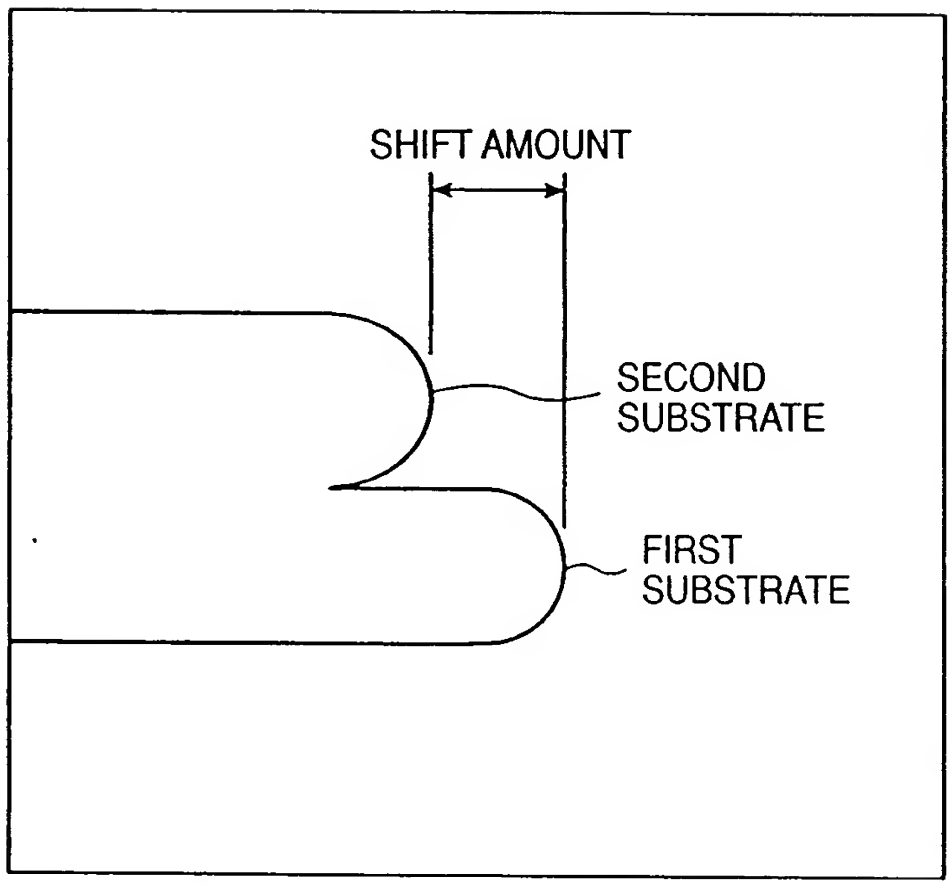


FIG. 30

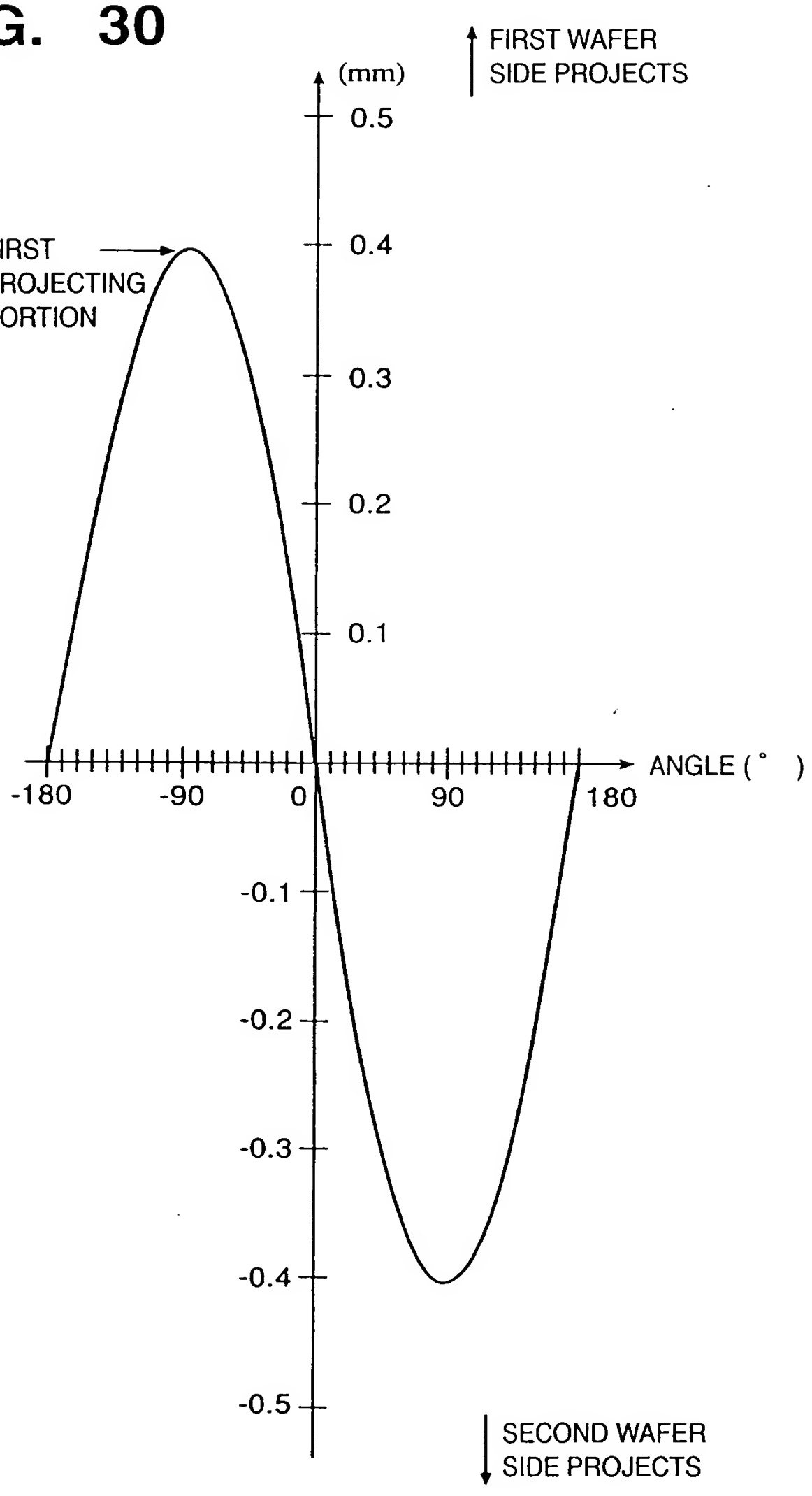
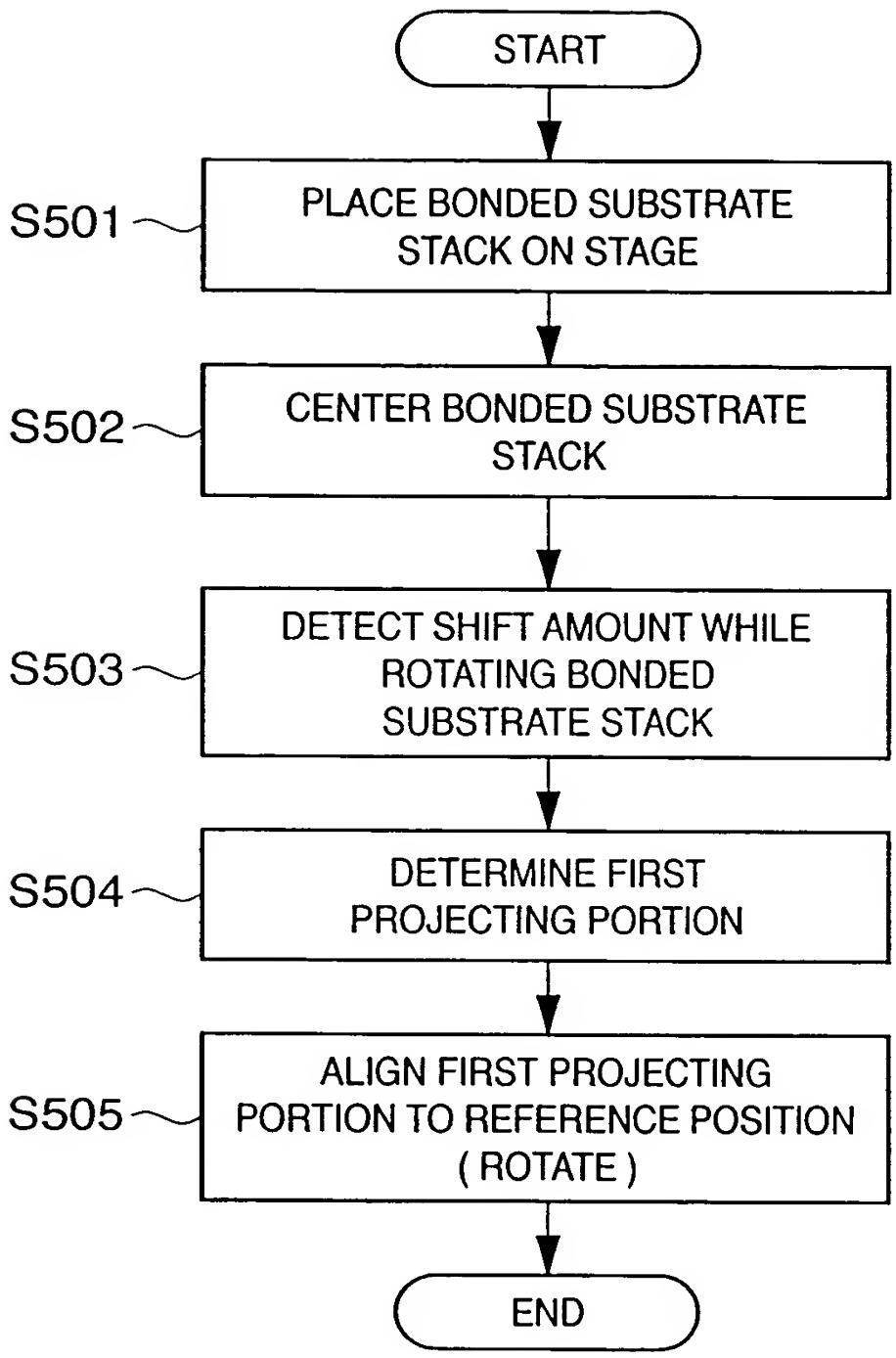

FIRST WAFER
SIDE PROJECTS
(mm)
0.5
0.4
0.3
0.2
0.1
FIRST
PROJECTING
PORTION
-180
-90
0
90
180
ANGLE (°)
-0.1
-0.2
-0.3
-0.4
-0.5
SECOND WAFER
SIDE PROJECTS

FIG. 31


START
S501
PLACE BONDED SUBSTRATE STACK ON STAGE
S502
CENTER BONDED SUBSTRATE STACK
S503
DETECT SHIFT AMOUNT WHILE ROTATING BONDED SUBSTRATE STACK
S504
DETERMINE FIRST PROJECTING PORTION
S505
ALIGN FIRST PROJECTING PORTION TO REFERENCE POSITION (ROTATE)
END

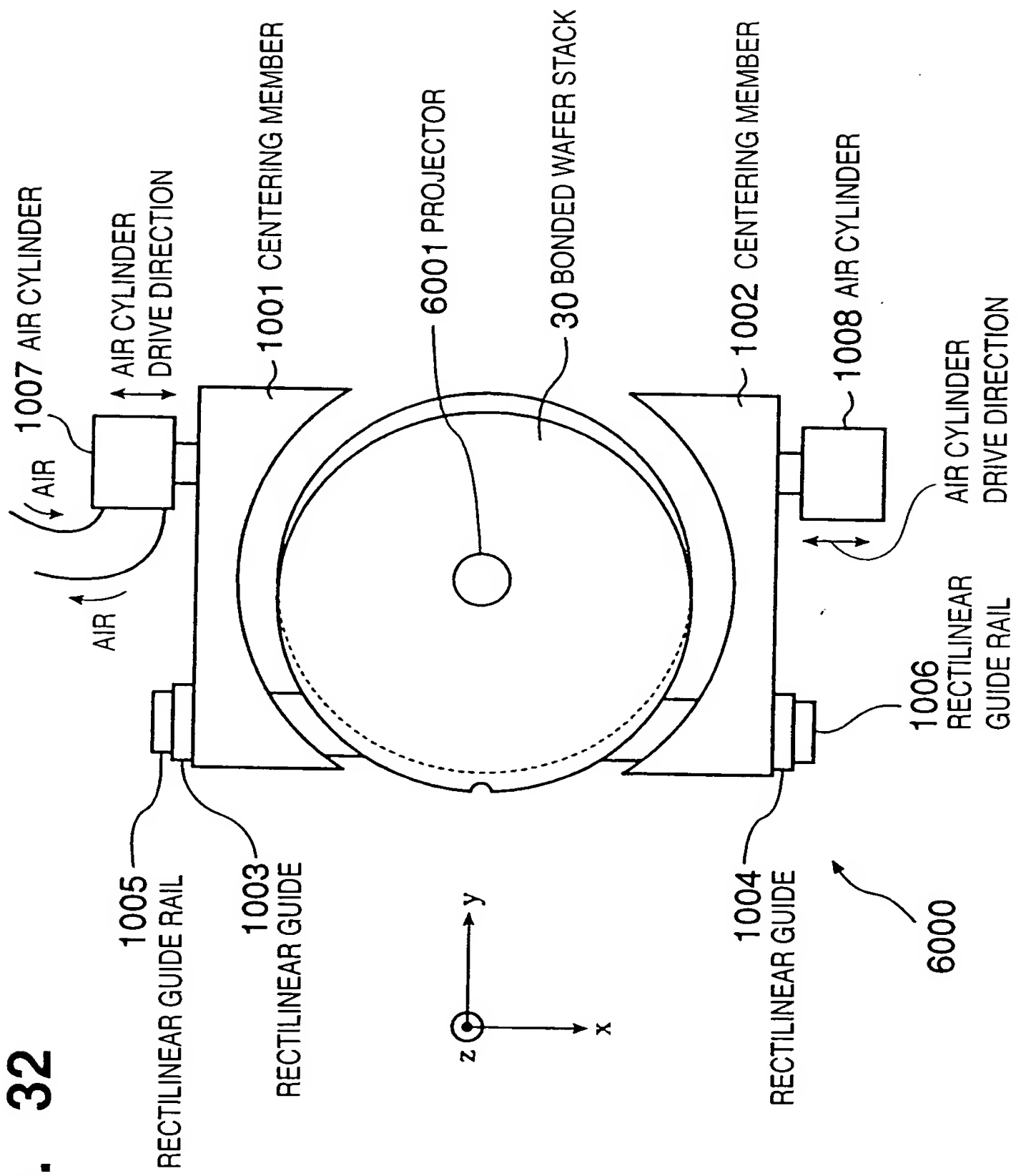

1007 AIR CYLINDER
AIR
AIR
AIR CYLINDER DRIVE DIRECTION
1001 CENTERING MEMBER
6001 PROJECTOR
30 BONDED WAFER STACK
1002 CENTERING MEMBER
1008 AIR CYLINDER
AIR CYLINDER DRIVE DIRECTION
1006 RECTILINEAR GUIDE RAIL
1005 RECTILINEAR GUIDE RAIL
1003 RECTILINEAR GUIDE
1004 RECTILINEAR GUIDE
6000
y
z
x

FIG. 32

FIG. 33

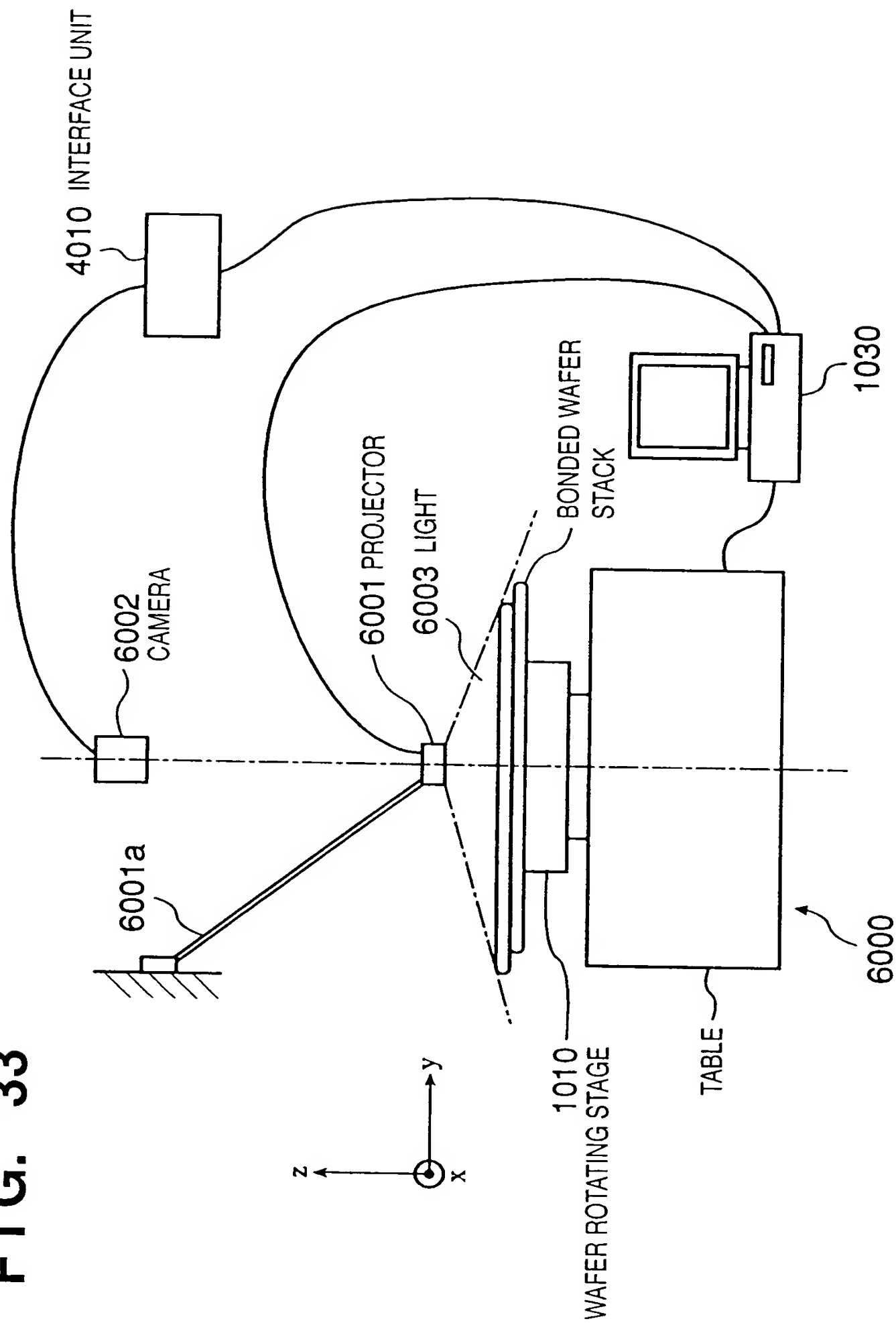

4010 INTERFACE UNIT
1030
BONDED WAFER STACK
6001 PROJECTOR
6003 LIGHT
6002 CAMERA
6001a
z
y
x
1010 WAFER ROTATING STAGE
TABLE
6000

FIG. 34

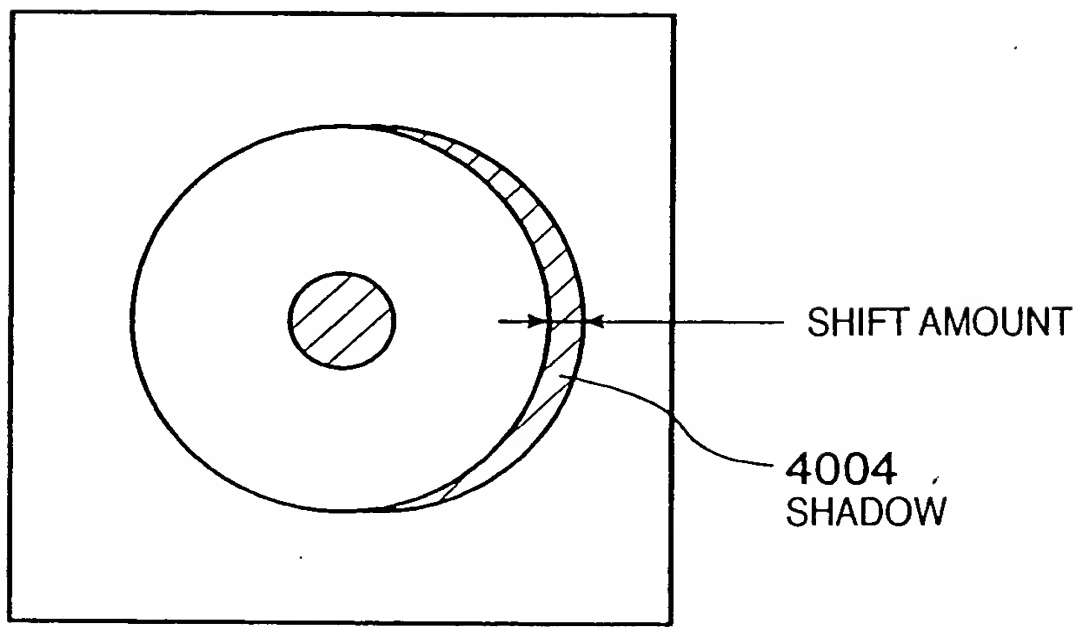


FIG. 35

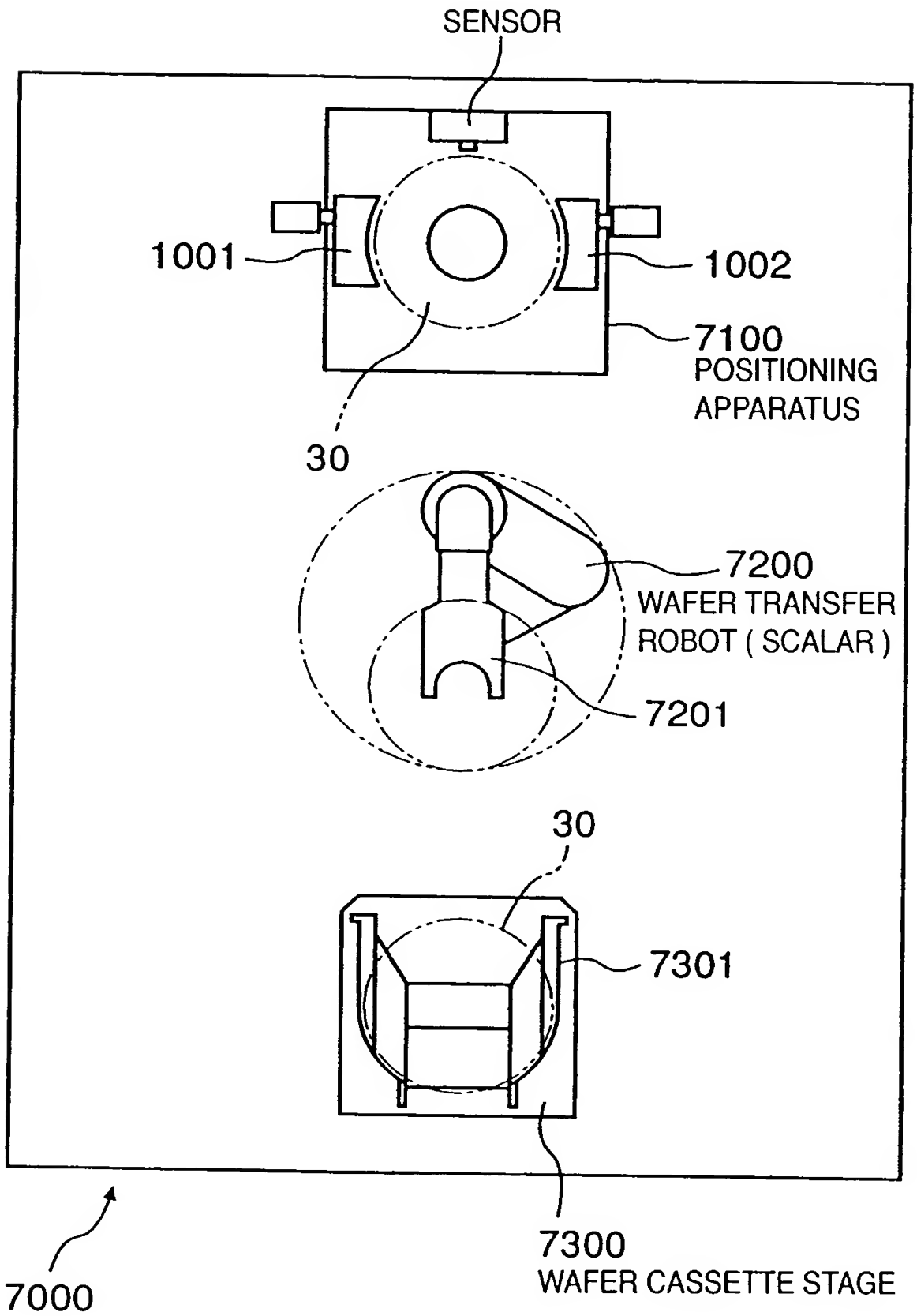

SENSOR
1001
1002
7100
POSITIONING
APPARATUS
30
7200
WAFER TRANSFER
ROBOT (SCALAR)
7201
30
7301
7300
WAFER CASSETTE STAGE
7000

FIG. 36

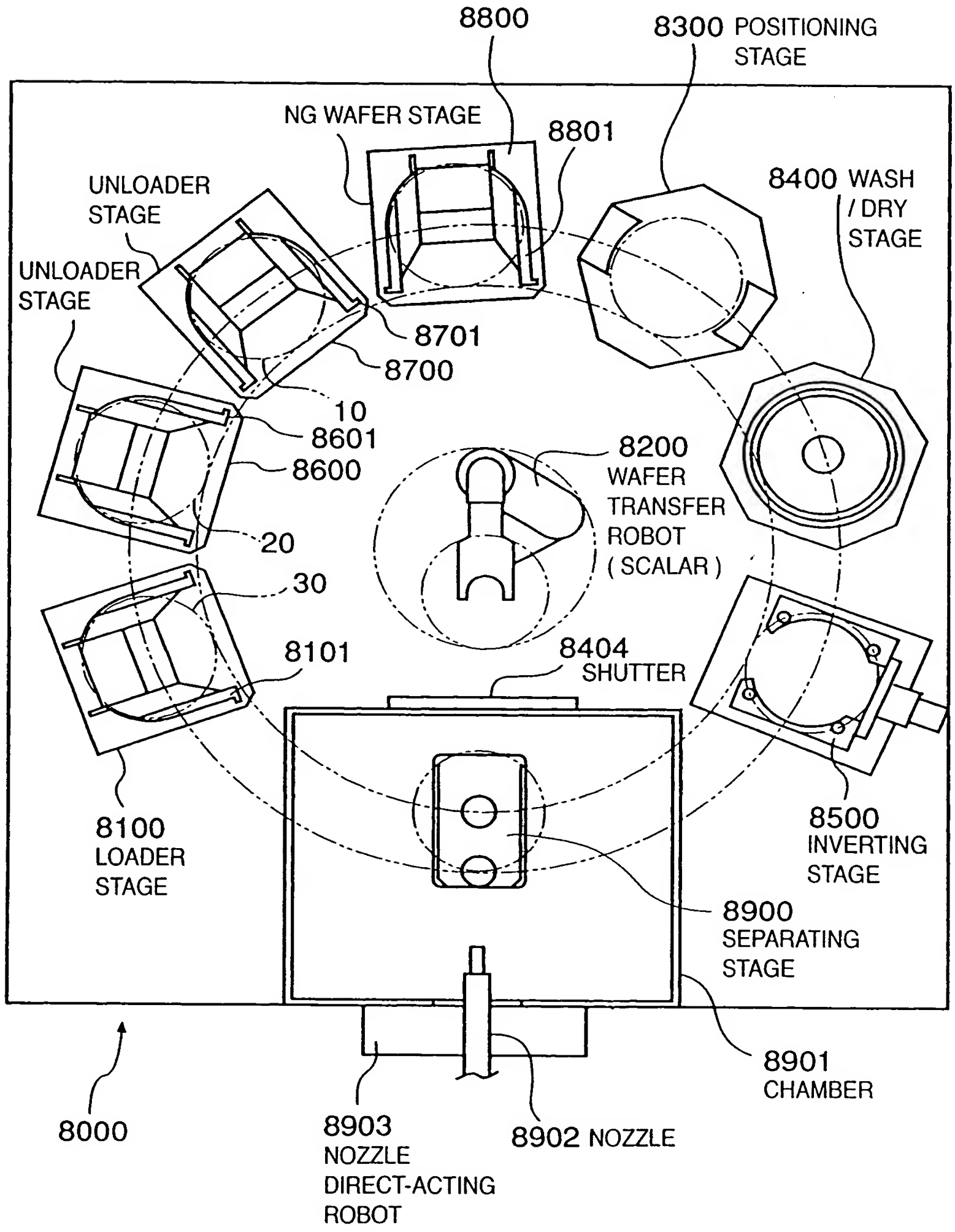

8800
8300 POSITIONING STAGE
NG WAFER STAGE
8801
UNLOADER STAGE
8400 WASH / DRY STAGE
UNLOADER STAGE
8701
8700
10
8601
8600
8200 WAFER TRANSFER ROBOT (SCALAR)
20
30
8101
8404 SHUTTER
8100 LOADER STAGE
8500 INVERTING STAGE
8900 SEPARATING STAGE
8901 CHAMBER
8000
8903 NOZZLE DIRECT-ACTING ROBOT
8902 NOZZLE

FIG. 37

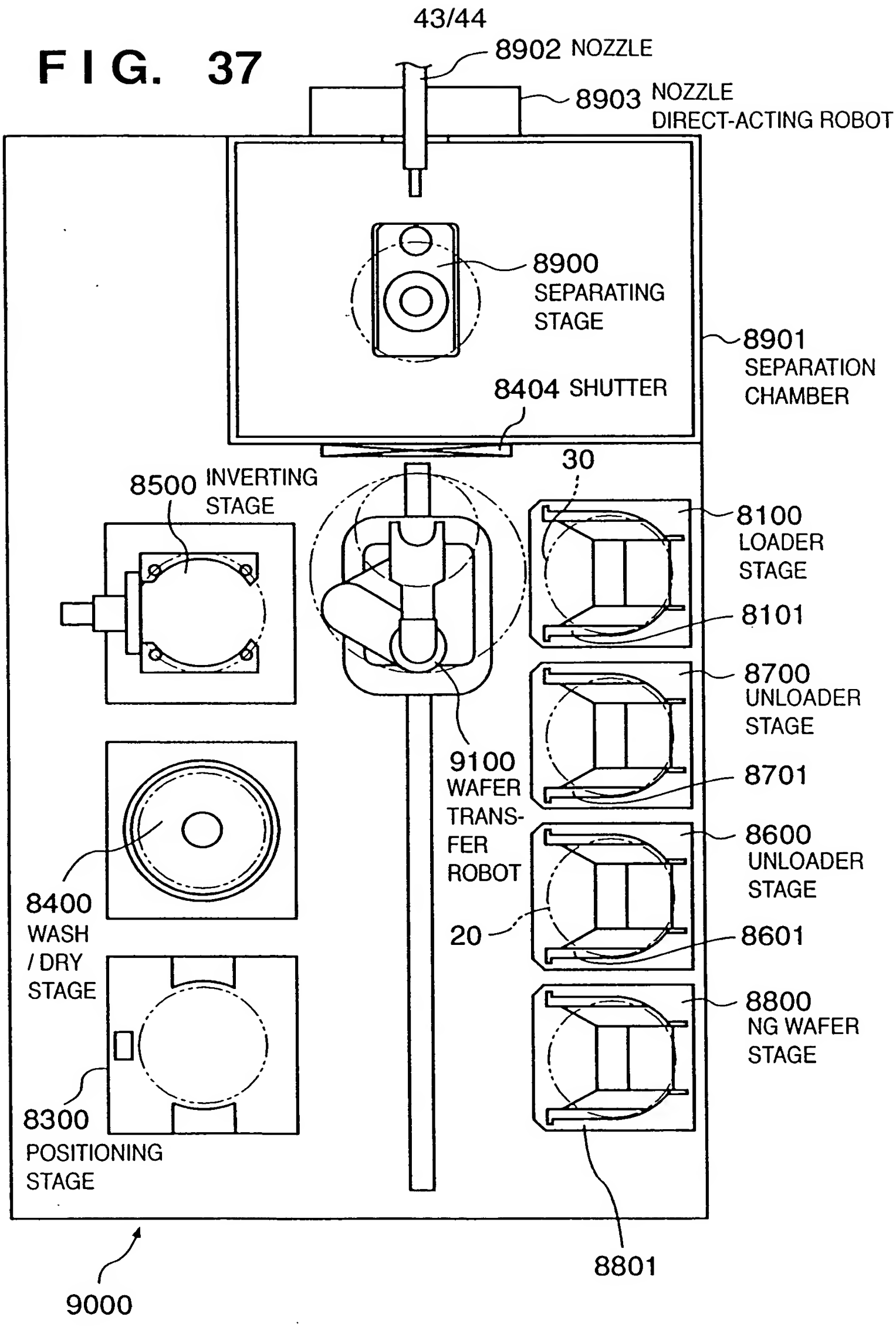

8902 NOZZLE
8903 NOZZLE DIRECT-ACTING ROBOT
8900 SEPARATING STAGE
8901 SEPARATION CHAMBER
8404 SHUTTER
8500 INVERTING STAGE
30
8100 LOADER STAGE
8101
8700 UNLOADER STAGE
8701
9100 WAFER TRANS-FER ROBOT
8600 UNLOADER STAGE
20
8601
8800 NG WAFER STAGE
8400 WASH / DRY STAGE
8300 POSITIONING STAGE
8801
9000

FIG. 38A

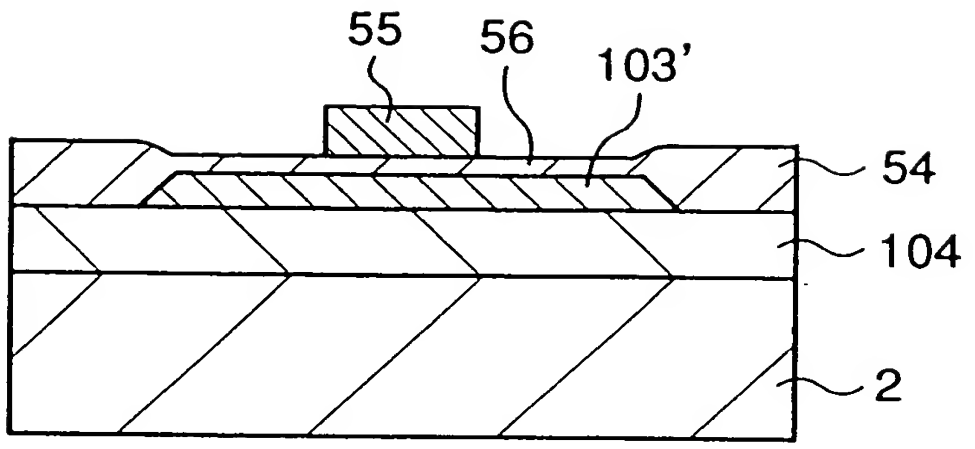


FIG. 38B

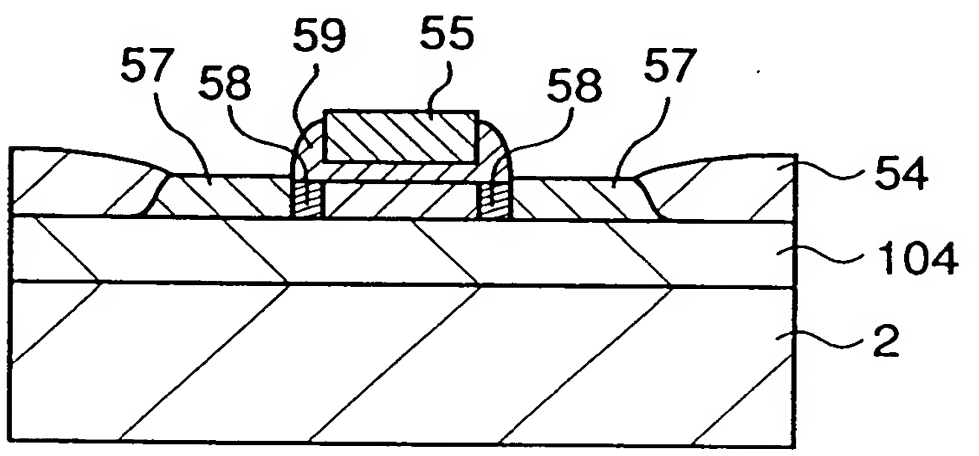


FIG. 38C

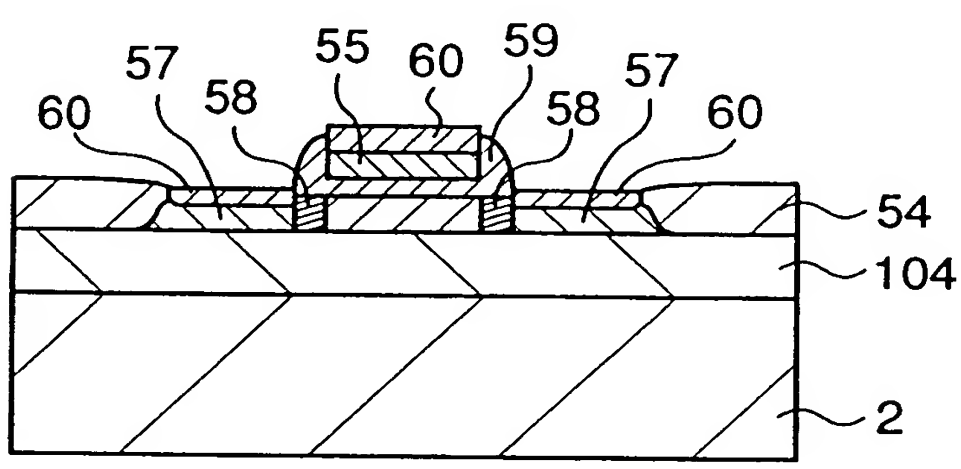
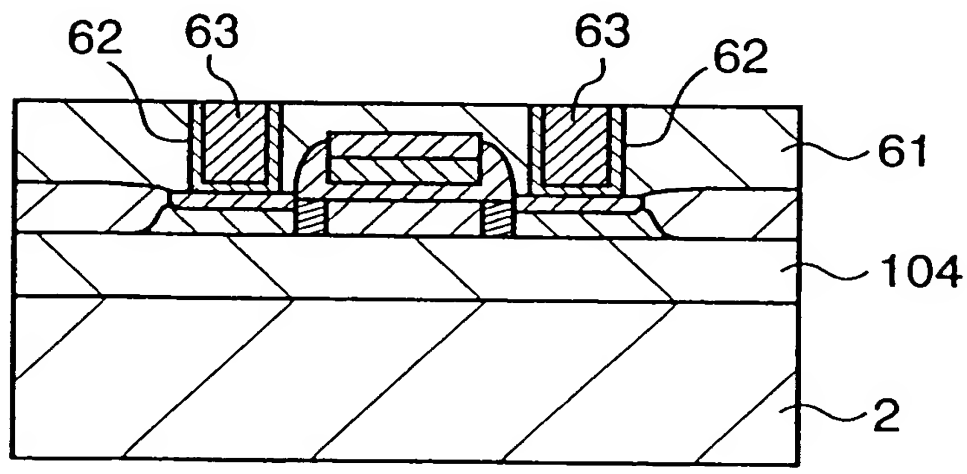



FIG. 38D